PRACTICAL ENGINEER

VOL. XVI CHICAGO, JULY 15, 1912 No. 14

TESTS OF LUBRICATING OILS

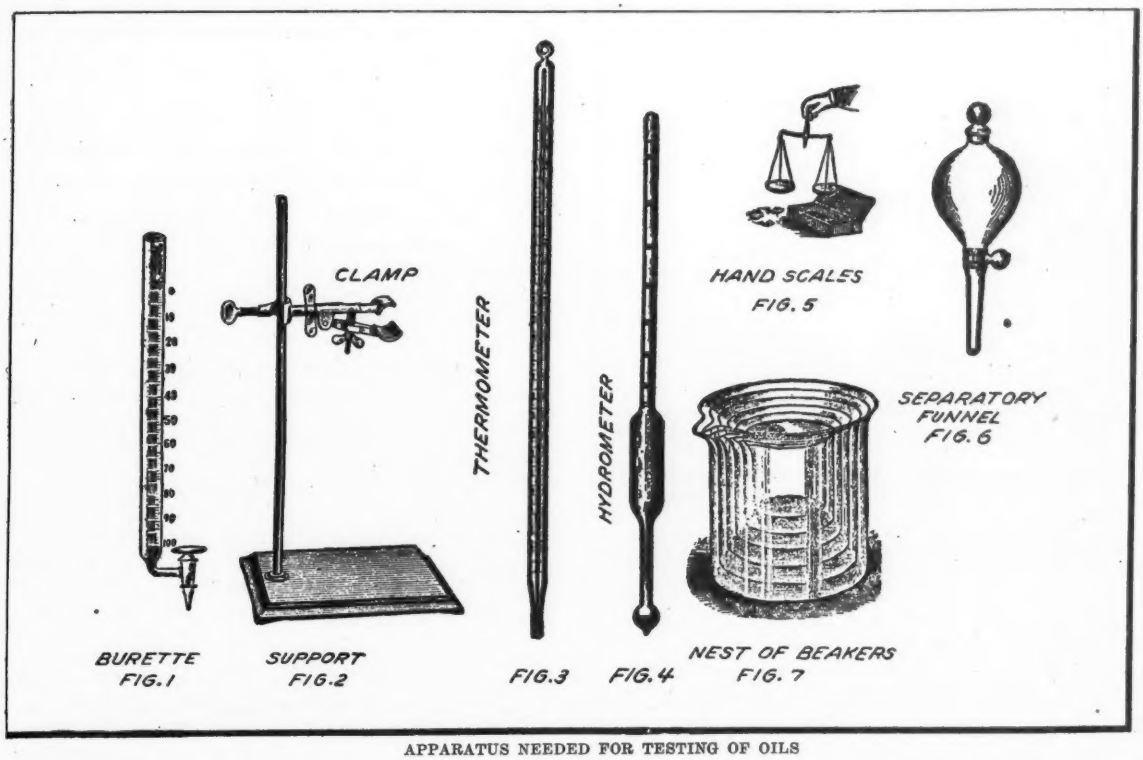
Easily Made in the Engine Room with Simple Inexpensive Apparatus, to Determine Qualities and Composition

BY FREDERICK E. DOBBS*

OWING TO THE INCREASED DEMAND for better and more efficient lubricating oils and greases and to the number of different grades and qualities of each, made necessary by the innumerable types of machinery in use at the present time, the manufacturers have been compelled to equip their refineries with very complete and up-to-date laboratories, and to employ chemical experts to have charge of them.

It is, therefore, possible for them to examine the oils and greases, which they produce, very carefully, and their recommendations may be safely relied upon in almost every instance.

On the other hand, it is difficult to turn out a uniform product in manufacturing oils and greases, and it should therefore be of considerable advantage to an engineer to be able to test out each shipment of oil to him upon its arrival at the plant, where he can tell at once whether or not the consignment is fully up to test as compared with a standard lot.



APPARATUS NEEDED FOR TESTING OF OILS

Samples of the oils which have been previously tried out and found to be O. K. must be secured in order that he may have these oils with which to compare each individual shipment.

The apparatus which will be needed in the tests is shown in the following list:

*Wentworth Institute, Boston, formerly Oil Expert with the Standard Oil Co.

List of Apparatus and Reagents

Apparatus

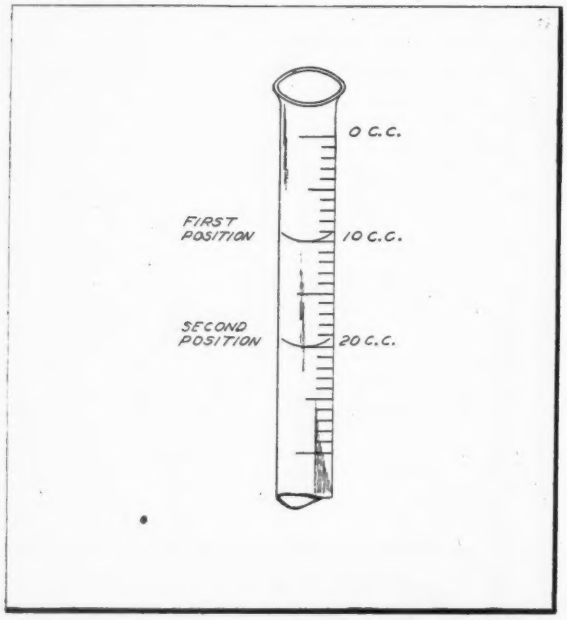
1.	1 25 cubic centimeter Mohr's burette, with Fresenins' glass stop cock, 1/10 subdivisions	$1.35
2.	1 support for burette, with one clamp	.75
3.	1 Thermometer from 10 to 600 deg	1.50
4.	1 Hydrometer, 0.7 to 1.0 specific gravity	.75
5.	1 hand scales with weights	.85
6.	1 separatory funnel, 8 oz	1.50
7.	1 fine mesh tea strainer	.10
8.	1 4-oz. glass breaker	.05
		$6.85

Reagents

½ gal. gasoline (88 deg. test)	$0.10
1 pint grain alcohol (90 per cent test)	.20
8 oz. caustic potash sticks	.10
	$0.40

Test Number 1—Viscosity

SAMPLES—Secure a clean 4 oz. sample of the oil to be tested and a 4 oz. sample of the oil to be used as a standard.



SHAPE OF OIL SURFACE IN BURETTE, AND 2 POSITIONS FOR VISCOSITY TEST

Temperature—Allow the two samples to stand until they are the same temperature, preferably between 60 and 80 deg. F.

Apparatus—Burette, support for burette with clamp, and a plumb line (a small piece of metal tied onto a piece of twine will suffice), fine mesh tea strainer, and thermometer.

Procedure—Rinse out the burette very carefully with gasoline. Fasten it in the clamp on the support, using the plumb line in order to get it in a vertical position.

Pour the oil to be tested into the burette through the fine mesh tea strainer until it is nearly full. Allow the oil to run out of the burette until it stands at 10 c.c., shutting off cock at that point quickly.

Owing to capillary attraction, the oil in the burette at the surface will be cup shaped. By getting the eye in the horizontal plane with the bottom of this cup it is possible to stop off the flow of oil when the bottom of the cup is at 10 c.c.

See that the burette is securely fastened in the clamp.

Then take hold of the stop cock with the right hand, and hold the watch in the left hand. Open the stop-cock and count the number of seconds it takes for the bottom of the cup-shaped surface of the oil to move from 10 c.c. to 20 c.c. It is extremely important that the stop cock be opened full every time.

Clean the burette again very carefully, and repeat this operation with the standard sample. A comparison of the number of seconds which it takes the 10 c.c. of each of the oils to run out will show whether the oil in question is lighter in viscosity or heavier than the standard sample.

Viscosity of a Cylinder Oil

THE viscosities of cylinder oils may be compared in the same manner provided that the engineer has a place where he can carry out the test at a temperature sufficiently high to keep the cylinder oil in a fluid state. A temperature of at least 100 deg. F. or more should be maintained in testing all cylinder oils.

The difference between the room temperature and the temperature for testing the oil should be as small as possible. More uniform results are obtained when the temperatures are the same.

Test Number 2—Specific Gravity

APPARATUS—A tin measure at least 10 in. deep, Specific Gravity hydrometer. Thermometer.

Procedure—Fill the measure up to within an inch of the top with the oil to be tested. Carefully place the hydrometer in the oil and allow it to float free. Note the point on the hydrometer scale at which the surface of the oil stands.

Remove the hydrometer, insert the thermometer and read the temperature of the oil.

Correct the hydrometer reading for temperature by subtracting 0.000,352 for every degree Fahr. above 60 deg. F. or add 0.000,352 for every degree Fahr. below 60 deg.

Example—Hydrometer reading = 0.909.
Temperature = 78 deg. F.
78 — 60 = 18.
18 × 0.000,352 = 0.006,336.
0.909 — .006,336 = 0.902,664.
Specific gravity = 0.903.

Test Number 3—Flash and Fire Test

APPARATUS—Thermometer. Small wax taper or substitute. Small iron receptacle (use a 2-in. or 3-in. pipe cap). Gas or oil burner suitable for heating. Support with clamp.

Procedure—Fasten the iron cap in the clamp, and arrange it so that the hottest point of the flame touches it. Fill a little over ¾ full with the oil to be tested, and suspend the thermometer from a point above so that the mercury bulk is submerged in the oil. Heat the oil at the rate of 15 deg. rise per minute. As soon as the oil is 300 deg. F. bring the lighted end of the wax taper near the surface of the oil. (Only a very small flame should be used.) Keep the flame there for only a short interval, but repeat the operation as the temperature increases, until the taper flame causes a quick flash on the surface of the oil, which only lasts an instant. Note the temperature at this point as the Flash-point.

Allow the temperature to continue increasing, repeat the operation of bringing the taper flame near the surface of the oil, drawing it away quickly each time, until the oil takes fire, and burns continuously. The temperature at this point is called the Fire Test.

Test Number 4—Cold Test

APPARATUS—4-oz. bottle with cork. Thermometer. Ice and salt.

Procedure—Secure a 4-oz. bottle which is long and narrow, and through the cork which fits it cut a hole large enough to enable the thermometer to be inserted. Pour about 1 oz. of oil into the bottle, insert the cork and thermometer and push the thermometer down into the bottle until the mercury bulb is submerged completely in the oil.

Then stand the bottle in a small dish containing a mixture of ice and salt, in such a way that the oil may be watched. Just as soon as the oil begins to crystallize remove the bottle from the cooling mixture, and note the temperature at the time the crystals disappear and the oil becomes clear again.

In testing a cylinder oil for cold test, the sample should be cooled off until it has solidified, and then the temperature noted at the time the oil will start to flow when the bottle is held in a horizontal position.

Test Number 5—Acidity

THE litmus paper test for the presence of acid is by far the simplest. Secure some red litmus paper, and add a piece about 1½ in. long to a small quantity of boiling water. If the water is neutral the paper will turn to light blue. (If the paper remains red it shows a presence of acid in the water, and that particular water cannot be used.) If the water is O. K. add a small quantity of the oil and allow the water, oil and litmus paper to stand for 5 or 10 minutes after thoroughly stirring.

If the litmus paper turns red it indicates the presence of acid in the oil. If it turns a deep blue it shows the presence of alkali. If it remains about the same color which it had in the water alone, it shows that the oil is practically neutral.

Test Number 6—Percentage of Animal or Vegetable Oils Present in Any Lubricating Oil

APPARATUS—Quart bottle with cork. Small enamel iron pan. Separatory funnel. Breaker. Hand scales and weights.

Procedure—Dissolve about 8 oz. of caustic potash sticks in a pint of water, and pour the solution into a quart bottle. Label this bottle "Caustic potash solution."

Weigh exactly 1 oz. of the oil and put into a clean iron pan, and add a mixture of 1 oz. of the potash solution and 8 oz. alcohol and boil slowly. As the alcohol boils away, add more until the contents of the pan have been boiling for at least 30 min. As soon as all of the alcohol is evaporated, remove the heat and allow the soap solution in the pan to cool. Rinse the separatory funnel out with hot water and add the mixture, rinsing out the pan into the funnel with about 3 oz. of gasoline.

Put the stopper into the separatory funnel, and shake up the contents, being careful to hold the stopper firmly in place while shaking.

Stand the funnel in a warm place until the contents are separated into 2 distinct parts; one, a mixture of mineral oil and gasoline, should form a clear layer on top, and the other, the soap solution, underneath.

As soon as a separation is obtained, very carefully draw off the soap solution from the funnel, not allowing any of the mineral oil to go out with it.

Add some clean hot water to the funnel which now only contains the mineral oil and gasoline, shake it up as before, allow a separation to take place and then drain off the water. Repeat 3 times.

Draw the contents of the funnel into the beaker and evaporate off the gasoline.

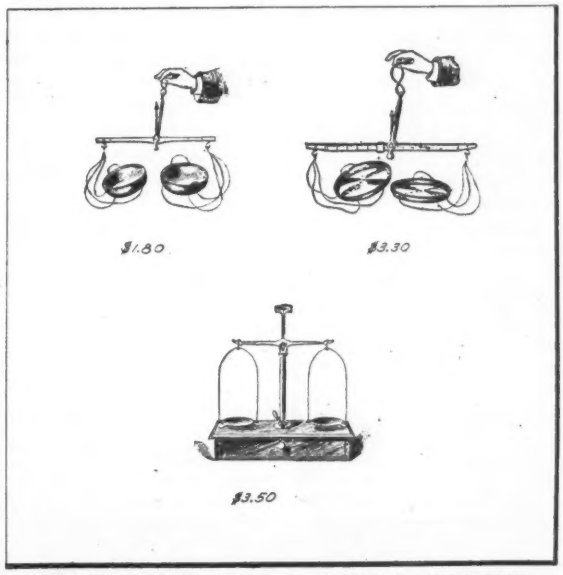
Weigh the remaining mineral oil. The difference between the original weight taken and the weight of the mineral oil will give the amount of fatty oils that were present in the 1 oz. taken. This will also be the percentage of fatty oil in the sample.

Test Number 7—"Thickener"

TAKE a small quantity of the oil which is suspected, on account of its great viscosity and stringiness, add a few drops of caustic soda solution and heat to about 250 deg. F. All of the false viscosity will disappear and the remaining oil will assume the viscosity and appearance of the original mineral oil used to make the thickened oil.

It is a simple matter to distinguish an oil which has true viscosity from a pulp thickened oil of about the same apparent viscosity.

The first oil will retain a large proportion of its viscosity under ordinary temperatures up to 212 deg. F., while the viscosity of the pulp thickened oil will drop away very rapidly with the rise in temperature, until all of the effects of the "thickener" will disappear before 212 deg. is reached.



STYLES OF MORE ACCURATE SCALES RECOMMENDED

I think that any engineer can understand these tests, and if they are carried out with any care at all, will give very good comparative results.

In the list of apparatus, I have left out the parts which I thought could be procured without extra expense, such as the gas or oil burner, and the enameled pan, and the pipe cap. These things can be found in almost any plant or at least a suitable substitute can be picked up.

I might say that the success that can be attained in making these tests depends, first, upon the engineer obtaining the correct pieces of apparatus, free from defects, and, second, upon his familiarity with the use of this apparatus.

In regard to the first point, I think it can be covered by some arrangement whereby any engineer who wishes a set of apparatus for these tests, be given the opportunity of buying it through Practical Engineer.

I would be glad to make up sets of apparatus, pack it up in good shape after carefully examining each piece, and ship it at the prices quoted (buyer to pay express from Boston). The only piece of apparatus which might be made selective are the hand scales. Some engineers might desire more accurate and expensive scales, which could be easily substituted for the difference in price.

We could suggest those illustrated as plenty accurate enough for the experiment. The second point can be covered, I think, by a sort of correspondence instruction. If any engineer writes that he is having difficulty in using any piece of apparatus or in following the direction for making any of the tests, we can write to him direct, giving him additional directions and suggestions.

I believe an engineer cannot know too much about lubrication and the different kinds of lubricants available, and if I can help with what information I have gained about this subject, I certainly will be glad to do so.

CONDENSING WATER COOLING RESERVOIR

Data From an Actual Case and Results Obtained

THE reservoir described in this article is located in the hill region of Pennsylvania at Wampum on a level 110 ft. above the river. As it was necessary to pump all water for the condensers this meant a considerable expense for power and a dam 275 ft. long by 18 ft. high of skeleton re-enforced concrete was built to impound about 6½ acres of water.

Engines used in the power house are 3 Ball & Wood compound-condensing 26 by 32 in. The air compressors are 2 in number, steam cylinders 12 and

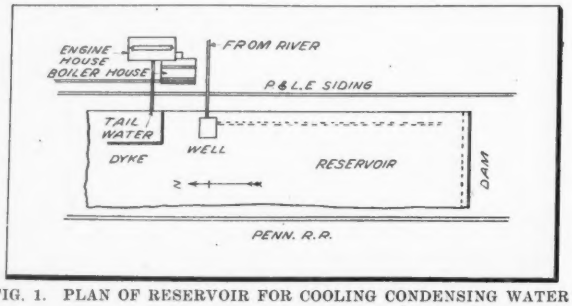


FIG. 1. PLAN OF RESERVOIR FOR COOLING CONDENSING WATER

21 in. diameter, air cylinders 11½ and 24 in. diameter, stroke 24 in. All steam is condensed in an Alberger barometric condenser equipped with dry vacuum pump and with circulating water supplied by a direct connected centrifugal pump driven by a synchronous motor.

Water from the condenser flows about 50 ft. through tile pipe into the east side of the reservoir about 100 ft. from the north end, a dyke being built south of this inlet and extending about 50 ft. toward the center of the reservoir and then nearly to the end in order to compel the circulating water to flow up and around this down toward the dam, a distance of about 1100 ft., before it reaches the intake to the power house.

To keep the reservoir supplied, a 150-hp. motor drives the centrifugal pump which has a capacity of 2324 gallons of water a minute and it is found that about 8 hr. pumping a week is sufficient to take of evaporation and seepage. This supply water is pumped into a well shown in the drawing and from the well flows through a tile on the bottom of the reservoir, as shown by the dotted lines. Intake water for the boiler

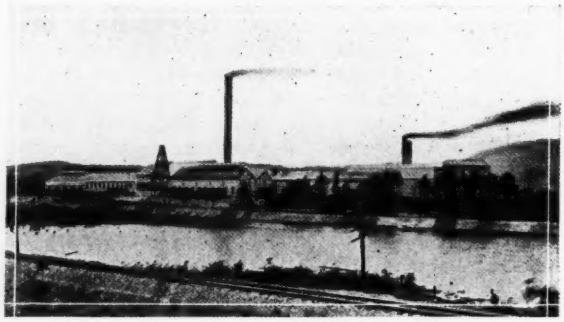


FIG. 2. THE RESERVOIR AND PLANT

feed and the condenser is also drawn from this well, so that the water must flow through the concrete tile pipe from the bottom of the reservoir at its deepest point in going to the condenser.

TABLE I. HEAT RADIATION TESTS ON CONDENSER WATER RESERVOIR

Area of reservoir, 288,000 sq. ft.; average depth of reservoir, 5.36 ft.; capacity of reservoir, 1,543,680 cu. ft. = 96,480,000 lb.

Date of Tests	Week ending May 7, 1911	Week ending July 12, 1911	Week ending November 27, 1911.
Amount of water pumped from river, lb.	10458956	29050875	4648140
Average temperature of river water, deg. fahr.	57.5	77	36
Average temperature of intake to power-house, deg. fahr.	72.75	91.43	61.71
Average temperature of tail water from condenser, deg. fahr.	101.36	129.43	90.71
Average temperature of reservoir, deg. fahr.	87.05	110.00	76.71
Average temperature of air, deg. fahr.	51.00	78.43	33.30
Average difference of temperature between water and air, deg. fahr.	36.05	31.57	43.41
Change in temperature of reservoir during test, deg. fahr.	0.25	7.00	2.00
Three 26 in. by 52 in. by 36 in. compound condensing engines, h. p-hr.	397807	411320	426936
Two 12 in. by 21 in., 11½ in. by 24 in. by 24 in. air compressors, h.p-hr.	46536	46536	46536
Average vacuum at 30 in barometer, in.	26.4	22.2	26.6
Average water consumed by engines, per h.p. per hr., lb.	14.46	15 64	14.41
Average water consumed by compressors per h.p. per hr., lb	18.85	20.12	18.83
Steam condensed by engines, lb.	5752289	6433045	6145148
Steam condensed by compressors, lb.	877204	936314	876273
Latent heat of steam condensed, lb.	1024 7	1007.1	1026.0
Heat delivered to reservoir by engines, b.t.u.	5894370000	6478720000	6304922000
Heat delivered to reservoir by compressors, b.t.u.	898871000	942961000	899056000
Heat to raise river water to average temperature of reservoir, b.t.u.	309062000	958679000	189226000
Heat given up or retained in reservoir during test, b.t.u.	24120000	675360000	192960000
Heat reduction in reservoir due to rain, b.t.u.	21630000	56700000	46200000
Heat absorbed by air and evaporation during seven days, b.t.u.	6438429000	5730942000	6564509000
Heat absorbed by air and evaporation. per sq. ft. of surface seven days, b.t.u.	22356	19899	23495
Heat absorbed by air and evaporation per sq. ft. per hr., b.t.u.	133.1	118.4	139.8
Heat absorbed by air and evaporation per sq. ft. per hr., per 1 deg. difference b.t.u.	3.69	3.71	3.22

Tests were taken at 3 different times in the season to determine the amounts of cooling by this reservoir. Each test was 1 week in length and the average horse-

power developed during the tests was 2446, the output being 3062 barrels of cement a day or about 1 barrel of cement for 0.8 hp.

The table herewith shows the results of observation and it appears that under conditions, in the northern part of the United States with engines using 15 lb. of steam per hour per horsepower with a vacuum of 26 in., a reservoir having a surface of 120 sq. ft. per hp. would be ample for cooling the condensing water.

Further data were given in the issue of July 1, p. 696.

THE VALUE OF EXHAUST STEAM IN ISOLATED PLANTS

I WAS hopeful of gaining some valuable instruction by Mr. Hubbard's comparisons but find his illustrations of the subject are not based on reasonable assumptions and his conclusions thereupon are therefore of no value.

In a recent issue, he assumes an office building in which the steam required for heating is 90,000 lb. a day for 100 days in the year, which proportion he then proceeds to relate to the assumed exhausts of 2 types of engines. Later on, he assumes that this average of 90,000 lb. exists during 10 hours service only, so the night and off-day steam for heating is ignored. 9,000 lb. average per hour is equivalent to a zero condition of 22,500 sq. ft., or on a proportion of 1 to 100 cu. ft.; the building would contain nearly 9½ millions of cubic feet contents. Where does such a large building exist, in a latitude having a heating season of 100 days? A further assumption is an evaporation of 10 lb. of water per pound of coal, which is not a practical attainment under office building conditions. Further, the writer takes no account of the unfortunate effects of low and variable load factors, which under actual conditions, in office buildings, largely increase the steam consumption on compound engines. Thus a 4-valve compound noncondensing engine operating a 200-kw. generator consumed as low as 19.7 lb. of steam per indicated horsepower, which rises to 26.8 at ½ load and 39.5 at ¼ load.

Similarly, a simple engine using only 33.5 lb. at full load per indicated horsepower will require 40.7 at ½ load, and 52 lb. at ¼ load, instead of the modest 30 lb. assumed by Mr. Hubbard.

Such unrelated assumptions destroy the value of the conclusions, and if based on practical conditions, the conclusions reached by the author might very probably be completely reversed. R. P. Bolton.

The example referred to is immediately preceded by this statement, "The following examples illustrate in a simple way some of the methods employed for determining the best form of equipment to use under a given set of conditions, and may be useful as a guide in solving problems of a similar nature."

An example of this kind, whether actual or theoretical, is of value only for the set of conditions given, and its use should be restricted to that of a more or less elastic formula, in which the actual values and conditions may be substituted. The limit set to the length of the article quoted did not allow of the introduction of many details which might affect the final result to a greater or lesser degree. The assumptions taken, however, are clearly stated and should not therefore be misleading. Referring to the particular points noted would say. (1) The relation of the steam required for heating purposes to the available exhaust is the important point, and not the size of the building, and this seems to be reasonable. Again, the steam included in the heating item covers that required for hot water service, and ventilation. The last item, in modern banking rooms, insurance quarters, etc., often considerably exceeds that for heating. These conditions were assumed in the problem. Estimating radiating surface upon cubic contents of building is now out of date in the best practice, but if I were to use this method I should say 1 to 50 cubic feet would be much safer than 1 to 100, as taken by your correspondent. Taking the above conditions into consideration I do not think the size of building and size of power plant are out of proportion.

(2) Ten pounds of water per pound of coal may be high for average office building practice, but is not at all unreasonable for plants of good size equipped with the best type of water-tube boilers carefully fired, which was the assumption in the problem.

The rate of evaporation was clearly stated so was not misleading in any way.

(3) It is further true that the load factor varies a good deal in this class of work. As space did not allow the plotting of curves showing the hourly relation between steam required for heating and exhaust available, conditions for the day were averaged, and it was assumed that the engine and generator units were so proportioned (as should always be done in practice), that the machine in use at different periods of the day would be running within economical limits.

(4) This item really comes first, and relates to the fact that no account is taken of night and Sunday heating. In certain localities it is customary to let steam go down at night, depending upon the stored heat in the building to prevent damage from freezing, even over Sunday, except in extremely cold weather. Whether this is wise or economical may be a question, but it is commonly done, and for simplicity was so assumed and plainly stated in the problem.

As this relates solely to the heating side, it has little to do with the cost of lighting and power.

Chas. L. Hubbard.

GRAPHITE AS A SURFACER

LUBRICATION is the life of a moving mechanical part. If you neglect lubrication or do it on a hit-and-miss principle, you pay for it by broken parts, shut-downs and other kindred troubles. The road to the junk heap is made an easy one if insufficient or inferior lubricants are used.

No matter how well you may think a piece of machinery is lubricated, unless provision is made for the time when oil or grease fail to do their duty (caused by an obstructed oil channel, overload, leaks, etc.), serious abrasion is likely to take place and it is then the lubricant which can stand up under adverse conditions, take its knocks and is not thin skinned, that protects against losses. Flake graphite will keep metal surfaces apart, because of its affinity for metal surfaces and its ability to knit up over them a covering, though, thin and unctuous to a high degree.

Prof. Goss says: "The tests show that with no other lubrication than flake graphite the journal and brass may be run together for hours at a time, heating up to a high temperature, and this may be done repeatedly, and yet the rubbing surfaces of the bearings remain unscored. As a protection against abrasion of rubbing surfaces, I know of nothing that can equal the record of flake graphite as herein disclosed."

GAS POWER APPARATUS

Producers, Engines and Industrial Applications

BITUMINOUS COAL GAS PRODUCERS*

Arrangement of Producers; Scrubbing Apparatus, Details and Efficiency; First Cost and Operating Cost of Plant

By C. M. Garland

FOR gasifying fuels containing over 12 per cent volatile matter, 2 lines of development have been followed: One is the down draft or double zone type, to draw the volatiles through part or all of the incandescent fuel thus converting them into fixed combustible gases; the other the up draft type with apparatus to separate the tar from the gases after leaving the producer proper.

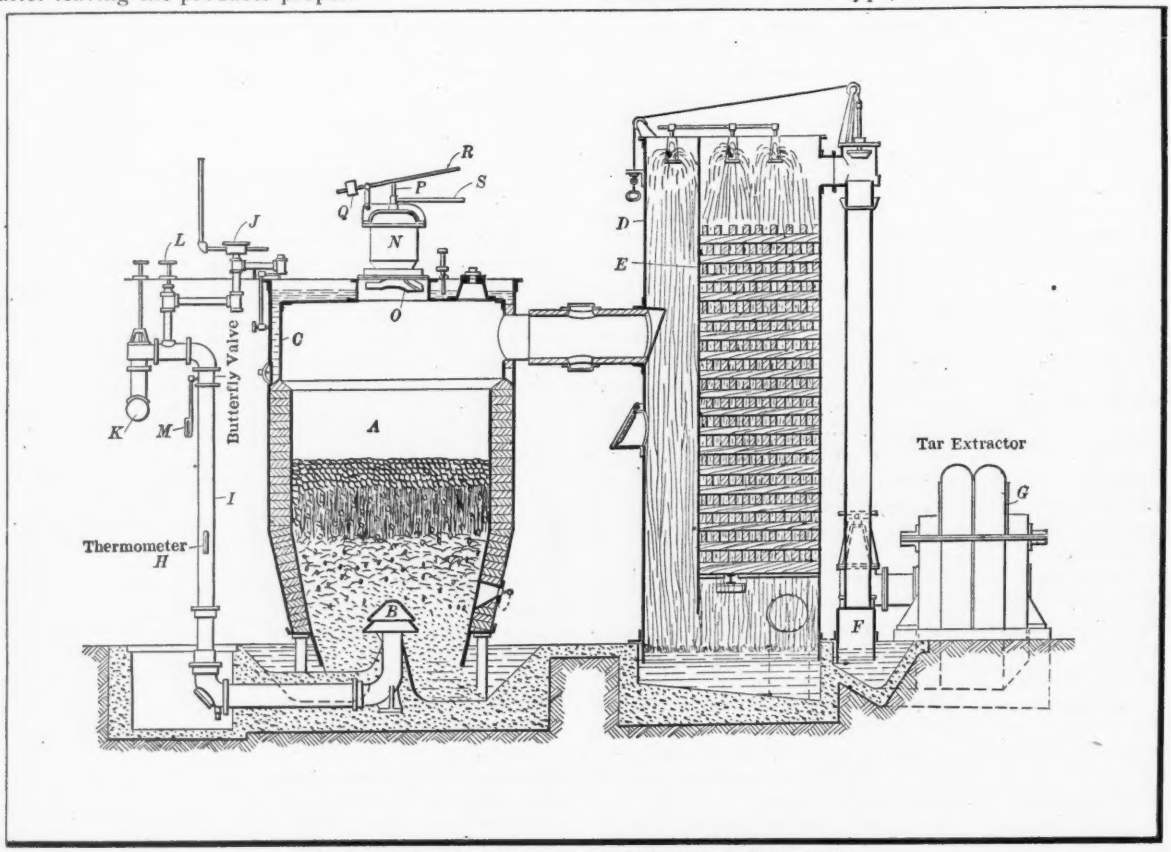


FIG. 1. SECTION OF PRODUCER PLANT FOR POWER GAS

Description of Apparatus

PLANTS are all of 2 general types, suction and pressure, varying principally in size and general arrangement. Figure 1 shows a vertical section through the producer, scrubber and the water-sealed gas main, which is characteristic of the arrangement of all later plants up to about 1000 hp. capacity. The pressure plant differs from the suction plant by the addition of a fan type blower, frequently installed in duplicate, and a regulating holder, which, in more recent plants, in most cases floats on the line so that the gases do not pass through it.

From Fig. 1 it will be noted that the producer A is of the water-sealed type, with central blast B and superimposed vaporizer C. The gases pass direct from the producer to the scrubber D, which is provided with a vertical baffle E from the scrubber to the water-sealed main F, and from this to the tar extractor G.

Referring to Fig. 2, the gas enters at A and meets a stream of water at B. The mixture flows upon the rotating vanes C and is thrown out into the stationary vanes D. The water and a portion of the tar is thrown

*From a paper read before the American Society of Mechanical Engineers at the Cleveland, O., meeting.

out against the casing E and follows this around to the drain F which discharges into the seal pit G. The gas leaving the stationary vanes D re-enters the rotating vanes H on the opposite side of the disk I, where it meets a stream of water from the nozzle J moving in the direction opposite to the gas which removes the remaining tar. The gas leaves at K.

Part of the steam from the vaporizer C, Fig. 1, passes into the blast pipe I, the steam pressure being maintained constant by the back pressure valve J, while the air pressure on the main K is also constant. The valve L is therefore used to vary the amount of steam delivered to the blast. Butterfly valve M, connected with the holder, regulates the amount of blast, but does not affect the relative proportions of air and steam.

Fuel is fed by the centrifugal charging device N, which insures even distribution of fuel. This consists of the hopper provided with the ribbed charging bell O, which is rigidly mounted on the shaft P and held against its seat by the counterweight Q. When the fuel is charged the bell is lowered by the arm R and at the same time rotated by the arm S, both arms being hand operated. After the fuel is charged, the counterweight Q causes the bell O to seat. A sliding cover closes the top of the hopper which prevents the escape of gas while dropping a charge of fuel.

Data for this paper have been derived from 7 different plants having capacity of from 125 to 900 hp. in use from 1.5 to 6.5 yr., under various conditions and with fuel varying from 18 per cent volatile, 73 per cent fixed carbon and 5 per cent ash to 51 per cent volatile, 16 per cent fixed carbon and 17 per cent ash.

Thermal Efficiency of the Producer

EFFICIENCY depends to a certain extent upon the amount of volatile matter contained in the fuel. For fuels containing as high as 30 to 50 per cent of volatile matter, the thermal efficiency based on the effective heating value of the gas is ordinarily 62.7 per cent. Where the volatile matter does not exceed 20 per cent the efficiency is somewhat higher, approximately 66.5 per cent.

In plants of the present type, however, more often it is a question of the adaptability of the producer to a given fuel or to several fuels and of continuity and reliability of operation.

Composition and Volume of the Gas

COMPOSITION of the gas and the heating value are comparatively uniform where proper attention is given to the operation of the producer. Calorific values by the calorimeter, taken every 2 hr. for 7 days, are plotted in Fig. 3. The average higher heating value of the gas was 144.1 B.t.u. per cu. ft. at 62 deg. F. and 30 in. mercury pressure. The average lower heating value was approximately 136 B.t.u. under the same conditions. For fuels containing greater percentages of volatile matter there is a tendency toward an increase in the calorific value of the gas due to the increase in hydrocarbons. With the lignites, for example, the higher heating value of the gas may average as much as 155 B.t.u. per cu. ft.

Volume of gas generated per pound of coal depends upon the composition of the coal and the condition of the fuel bed. In the seven-day test the volume per pound of run of mine Pocahontas coal was approximately 71.5 cu. ft. For lignite the volume of standard gas varies between 36 and 40 cu. ft. per lb.

Cleanliness of the Gas

A LARGE number of tests have been made on the cleanliness of the gas delivered by the tar extractors in the above plants, the results being given in Table I. From these it will be seen that the amount of solid matter in the gas has been reduced to a very small quantity and averages 0.0206 grains per cu. ft. of standard gas. The efficiency of the tar extractor, given in several cases, was taken as the ratio of the weight of solid matter in the gas leaving the extractor, to the weight of solid matter in the gas entering the extractor, multiplied by 100.

Determinations were made by drawing samples of the gas through 3 thicknesses of filter paper on which the solid matter was deposited, in most cases simultaneous samples being taken from the entering and exit sides of the extractor, and measured by calibrated meters.

Experience seems to indicate that with 0.03 grains of solid matter per cu. ft. in the gas, engine valves require cleaning once in 2 or 3 weeks, hence with the extractors in use there is no trouble from this source in plants that are properly operated and the cleaning of the valves would not be considered a hardship.

Handling the Tar

IN earlier plants considerable difficulty was experienced by the tar accumulating in the scrubbers and pipe lines, which caused frequent shutdowns.

At the present time and for the more modern plants it can be safely said that trouble from this cause has almost entirely ceased. The water-sealed gas main has solved the piping difficulty, while refinement in the design of the other parts and close attention to detail has accomplished the same effect for these.

In so far as the yield of tar is concerned, there are but 3 objections that can be urged against this:

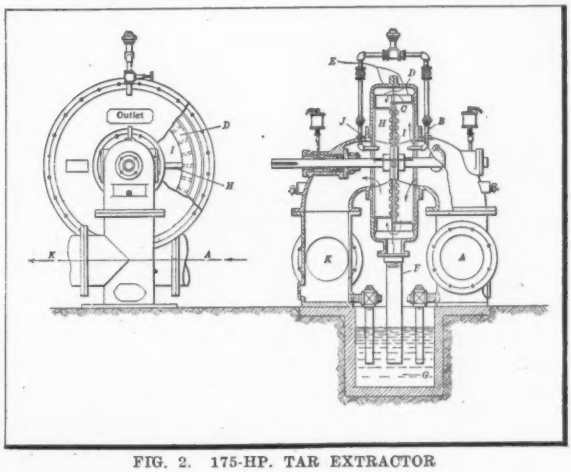


FIG. 2. 175-HP. TAR EXTRACTOR

(1) Loss in efficiency of the plant due to the removal of a combustible constituent from the fuel.

(2) The expenditure of power in the driving of the tar extractor for the removal of this constituent.

(3) Difficulties in the disposal of the constituent.

Taking it for granted that the tar in every instance can be disposed of satisfactorily, as it can be, the answer to these objections is that it is entirely a question of economy and, if it does not pay to handle this element, then bituminous coal is either not the fuel to use, or a producer plant is not the kind suitable to the conditions.

The magnitude of the above items is fairly well known. The loss in thermal efficiency (1) varies from 12 per cent for fuels containing from 15 to 20 per cent volatile matter to 17 per cent for fuels containing above or near 30 per cent of volatile matter.

The amount of power (2) required to drive the tar extractor depends upon the nature of the tar produced. With lignites, for example, which produce a thin yellowish tar resembling very nearly a heavy oil, the power required is at least 25 per cent less than the amount required for bituminous coals. For bituminous coals this power varies from 5 per cent of the power of the plant in a plant of 100 b. hp. to about 3.5 per cent for a plant of 1000 b. hp., and it is believed that this figure will be reduced almost ½ in the near future.

As to the difficulties in the disposal of the tar (3) there is in some instances a ready market for the tar product so that this may be disposed of to advantage. In other cases where boilers are in service, it can be burned without difficulty under these boilers.

The usual method of handling the tar is to place the extractor over a pit containing water into which the mixture of tar and water from the extractor is discharged. The pit is arranged so that the tar may be skimmed from this into a barrel or receiver. Where

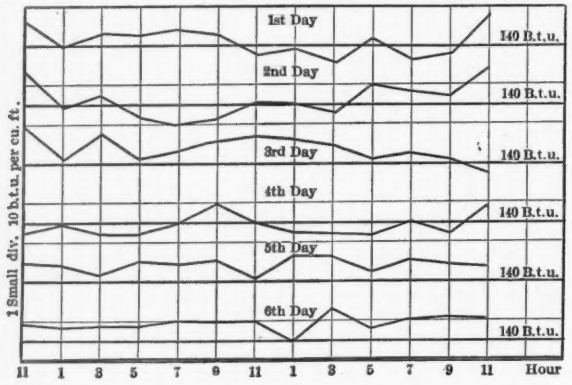


FIG. 3. HEATING VALUE OF GAS FOR 6 DAYS RUN, SHOWING UNIFORMITY

a receiver is used it is provided with an air tight cover, and when the receiver is filled the cover is put in place and either steam or air under pressure placed above the tar, which forces it through piping to the point of disposal. Where the tar is thick and heavy, it is necessary to provide the receiver with a steam coil to keep the tar in a fluid condition.

Fuel Required

IT can almost be safely said that any fuel can be used in any well designed producer of the up-draft type. If the fuel can not be used the probabilities are that the fault is either in the operation or in the design of the producer. The reason for this is that there are but 3 fundamental requirements for the successful gasification of a fuel. These are, uniform distribution of the blast, uniform distribution of the green fuel and uniform removal of ash. These 3 are essentially one as they are so closely related and interdependent that they reduce to uniform distribution of the blast.

When these requirements have been met in the design of the producer, the writer has never found a fuel that could not be gasified, at much higher rates and with much less labor than is considered possible by the majority of engineers.

An example in which the difficulty lies in the operation of the producer is illustrated in the case of Texas bituminous coal. This was a highly caking, and the operators of the producer stated that it was impossible to use this fuel in the producer. After observing the operation for a few hours it was found that the difficulty was due to the caking properties. When full hoppers of fuel were dropped upon the hot bed, the fuel fused into a solid mass through which the blast could not penetrate. By charging a half hopper of fuel every 15 min. in place of a full hopper every 30 min., there was no further difficulty.

Reliability

FROM the last reports obtained about one year ago, one plant of 190 hp. had been in successful operation for over 5 years without a shutdown and without having the fire drawn from the producers. Figure 3 shows the heating value of the gas taken every second hour for 144 hr. continuous running; 2 8-ft. producers were in operation for the full period. The engines pulled an average load of 568 kw. with a maximum of 640 kw. for 1 hour, and a minimum of 405 kw. for 1 hour. The coal consumption was 1.78 lb. per kw.-hr. at the generator terminals, including a 24-hr. standby, and the rate of gasification was about 10 lb. of coal per sq. ft. of fuel bed per hour. The fuel used was Pocahontas run of mine.

In one of the most successful lignite plants which operates a cotton meal mill the latest reports state that lignite screenings, costing less than 50 cents per ton, are being used successfully.

Another plant showed a fuel consumption of 1.65 lb. of coal at full load per kw.-hr. at the generator terminals, 1.89 lb. at ¾ load and 2.2 lb. at ½ load, when operating on Pocahontas coal. On New River slack the coal per kw.-hr. is approximately 1.6 lb. at about full load.

Plant B was reported unsatisfactory. It was found on investigation that for 2 yr. the plant had been operated from 18 to 24 hr. a day and the station logs showed that the engine had pulled a 25 per cent overload for about 2 hr. during the peak every evening. Any fuel that could be picked up in the open market was used, and the man that operated the producers also fired 2 boilers for running about 400 hp. in high-speed steam engines.

TABLE I. TESTS OF EFFECT OF TAR EXTRACTOR

Plant	No. of Determinations	Fuel	Per Cent Volatile	Grains Solid Matter, Cu. Ft.	Efficiency Extractor, Per Cent
A	1	Illinois Coal	31.0	0.0150	96.0
B	2	Texas bituminous	47.0	0.0062	99.5
C	11	Pocahontas	17.7	0.0163	98.5
D	1	Pocahontas	21.7	0.0585	93.5*
E	2	Texas lignite	51.2	0.0050	99.5
F	2	Pocahontas	22.8	0.0227	....

* Tar extractors operated at 1000 r.p.m., instead of 1500 r.p.m. rated speed. Dry scrubber used beyond tar extractors in this plant; solid matter in gas leaving dry scrubber 0.0421 grains per cu. ft.

Costs

COST of producer plants and of operating are by no means fixed quantities, so that it is difficult to give figures that are general and that can be safely applied to any and every case.

The first cost depends upon; the service or load conditions, continuous, intermittent, or variable; upon the design of the producer; upon the method of generating steam for the blast; upon the characteristics of the fuel; upon the percentage of ash; upon the scrubbing apparatus required; upon the method of handling the coal; upon local conditions.

Operating costs are intimately connected with the first cost and depend upon the same factors and also the coal-handling machinery; facilities for handling the tar; supervision.

In order to analyze the different costs and indicate their approximate magnitude for pressure plants ranging in size from 500 to 1500 b. hp., a proposition will be assumed wherein it is required to develop from bituminous coal of known properties, approximately 1200 net b. hp. in excess of the power required to operate the producer auxiliaries.

It will be assumed that the load conditions are such that 3 units are desirable and the costs will be based on full load operation 365 days a year, 24 hours a day. From these costs the effect of various load factors may be investigated.

The following assumptions will be made:

Coal.....13,500 B.t.u. per lb. calorimeter determination or high value.	
Cost per ton delivered	$1
Per cent volatile matter	32
Per cent ash	8
Efficiency of the producer based on the effective heating value of the gas, per cent	62.7
Effective B.t.u. required by the engines per b. hp. at full load	10,500
Effective B.t.u. per lb. of coal 13500×62.7÷100.	8465
Lb. coal per b. hp.-hr.=10500÷8465	1.24
B. hp. required for tar extractor	30
B. hp. required for fan blower	5
B. hp. required for scrubber water pump	5
Total auxiliaries hp.	40
Total b. hp. required	1240
Total lb. coal per hour=1240×1.24	1538
Area of fuel bed required at 10 lb. gasification per sq. ft.	153.8
Three producers 8 ft. inside diameter will be required. These would have a continuous overload capacity of 25 per cent, and 50 per cent for 3 hr.	
Area of fuel bed of each producer, sq. ft.	50.26

Each producer should be of the water-sealed type for continuous operation since the fuel is a bituminous coal of medium grade containing a fair amount of ash. The steam for the blast may be obtained by the use of a superimposed vaporizer, a vaporizer placed between the producer and the scrubber, an exhaust boiler or an independently fired boiler. The latter is very uneconomical and has a high initial cost, so that it is not used in power work at the present time. The exhaust boiler is economical provided there is no other use for the steam that may be thus generated. The first cost is, however, high, and as in many cases it must be located at a distance from the producers and requires more or less attention, its use in plants of this size and for this purpose is hardly justifiable.

The vaporizer or boiler between the producer and scrubber, while an excellent arrangement for anthracite plants, is unsuitable for bituminous coal plants on account of the solid matter that is carried in the gas.

The superimposed vaporizer therefore remains as the last choice. This is low in first cost and while it absorbs a certain amount of radiant heat from the fuel bed, which could otherwise be utilized, it is convenient, requires little or no attention and essentially no repairs, so that for small and medium sized bituminous plants it is the most economical method of generating steam for the producers, and will therefore be selected.

To each producer a static scrubber will be connected, as shown in Fig. 1. These scrubbers will in turn connect to a water-sealed gas main. Since the plant is to operate continuously, 2 tar extractors and 2 fan blowers will be required, one of each for a spare. The tar extractors and fan blowers should be driven by electric motors direct connected; 35 or 40-hp. motors will be required by the former, while 5 or 7½-hp. motors will be required for the latter. The coal-handling apparatus will consist of a 30-ton coal bin located above the second producer with spouts to the coal hoppers of each producer. A track bin will be located near the producer house and an elevator used for delivering the coal from the track bin to the 30-ton coal bin above the producers.

The ash removed from the water seals of the producer will be loaded into a small car which may be hoisted into either a railroad car or ash wagon by means of a block and tackle or an air lift.

The building will be of steel frame construction with corrugated iron sides. A charging platform will be built around the producers.

For an equipment of this nature, the cost of the producers and auxiliary apparatus erected on the foundations, including the charging platform but not including freight, will be approximately:

Per b. hp. of the engine	$11.20
Foundation per b. hp. of the engine	0.48
Coal handling apparatus per b. hp. of the engine.	1.42
Building 50 by 45 ft. per b. hp. of the engine (not including land)	2.25
Total	$15.35

The operating costs may now be taken as follows based on coal at $1 per ton of 2000 lb. and brake horsepower:

Interest, depreciation, taxes, insurance at 13 per cent per annum per b. hp.-hr. (8760 hr. per yr.), cents	0.02280
Maintenance and repairs, this may be taken at 1½ per cent of the first cost per annum, cents	0.00270

The item of supplies is variable and depends somewhat upon the behavior of the fuel. If it is a clinkering fuel, the cost of bars for poking in itself may amount to quite an item. The total should not amount to over $200 per annum for average conditions, or 0.00185 cents per b. hp.-hr.

Labor is also a variable quantity, depending upon the behavior of the fuel, upon the management and upon the amount and kind of coal, ash and tar handling apparatus installed. With a fairly good fuel, 3 men per shift of 12 hours should handle the plant with ease. The price for labor varies with the location, but $3 per day for the chief operator and $2 per day for his five assistants is ample. This makes a total of $4745 per year, or $0.0437 b. hp.-hr. (This cost seems too low both for number of men and wage. Editors.)

The cost of fuel has been taken at $1 per ton and at full load the coal per year will be 1538×8760÷2000=6745 tons or $6745, or 0.062 cents per b. hp.-hr.

We have therefore

	Per b. hp.-hr.
Interest, depreciation, taxes, etc.	0.02280 cents
Maintenance and repairs	0.00270
Supplies	0.00185
Labor	0.04370
Fuel	0.06200
Total	0.13305 cents

The total cost of operating the producer equipment at full load is 0.133 cents per engine b. hp.-hr.

If it is assumed that the gas generated has an average low calorific value of 136 B. t.u. per cu. ft. of standard gas, 8465÷136=62.2 cu. ft. will be generated per lb. of coal, and 10500÷136=77.2 cu. ft. will be required per b. hp.

From the above 1000 cu. ft. of 136 effective B.t.u. gas will cost 1.72 cents. This figure, as above noted, does not include the cost of land for buildings, freight, nor the cost of scrubber water, which in many cases is obtained at the cost of pumping.

From the above figures the cost of power for any given load factor may be obtained and for any given cost of fuel. The power required by the producer auxiliaries remains practically constant, also the fixed charges and labor, unless in the case of the latter the load factor is sufficiently low to dispense with one producer operator per shift. The only variable is therefore the amount of coal used which may be determined from the number of hours of operation and the heat consumption of the engine at different loads, on the assumption that the producer efficiency is constant at all loads from 25 per cent to 1.25 per cent.

Future Developments

THE future is promising, as more economical results are now recognized as attainable, through increase in the rate of gasification, decrease in power required to drive the cleaning apparatus, utilization of waste heat.

From study and investigation it has become apparent that average fuels can be gasified at rates from 50 to 150 per cent greater than the present rating of producers (9 to 10 lb. per sq. ft. of fuel bed per hour), and with no increase in labor. This means a great reduction in the first cost of producer plants and also in the operating costs. Furthermore, the same principles produce the same results in large producers as in small producers, so that it is just as practicable to build a producer of large as of small diameter, while the labor per square foot of fuel bed required in the operation of the producer, the first cost, and operating costs are greatly reduced. A producer 9 ft. in diameter inside the lining, having an area of 63.6 sq. ft., requires less labor to operate than 2 producers 6 ft. in diameter (area 56.5 sq. ft.), while the quality of the gas is more uniform than that obtained from one of the smaller units. The same is true of the producer 10½ ft. in diameter, which is easier to operate than 2 producers 7 ft. in diameter. It is, however, true that the gas from 2 smaller producers will problably be more uniform in quality than the gas from one large producer. In any case where continuous operation and uniform condition are essential, at least 2 units should be installed.

The writer's experience would indicate that producers up to 15 ft. inside diameter are practical.

Utilization of the waste heat is an item that has received some attention in the past, but not as much as it warrants. As a rule, the average gas plant is extremely wasteful of heat. About 12 per cent of the heat in the fuel is thrown away in the scrubber water, while about 60 per cent is thrown away in the cooling water to the engine cylinders and in the exhaust. These last 2 quantities are available for steam raising in the bituminous coal plant. Approximately 2½ lb. of steam can be generated per b. hp. of the engine. Where there is a fairly uniform load and a demand for this steam, it can be obtained at a comparatively small cost and when credited against the cost of gas at the same rate as the cost of steam by direct firing, reduces the cost of gas from the plant from 12 to 20 per cent. If there is no demand for steam for heating or other purposes it may be used for the generation of power either in engines or turbines.

In the case of the 1240-b. hp. plant just considered, 3100 lb. of steam can be obtained from the engine exhaust and jackets per hour. The exhaust boilers would cost erected, including foundations, about $2000.

For good economy the exhaust boilers should be of the low-pressure self-contained type, generating steam under about 5 or 10 lb. pressure. The heating surface should be approximately twice the amount per boiler horsepower used in direct-fired boilers. It should not, however, be sufficient to reduce the temperature of the leaving gases below 220 deg. F., unless a cast-iron boiler is used.

Interest, depreciation, repairs, maintenance, etc., on $2000 at 14½ per cent per annuam is $290, or 3.31 cents an hour. The steam if generated in a small direct-fired boiler would cost about 9 cents per 1000 lb. when using coal at $1 per ton. The credit for steam is therefore 3.1×(9—3.31) cents per hour, or 0.0145 cents per b. hp.-hr. The cost of operating the producer equipment per b. hp.-hr. would be therefore 0.133—0.0145=0.1185 cents.

WHEN SAWDUST or wood pulp is used as part of the aggregate in mixing, the resulting concrete is of light weight and low tensile strength, but has some special properties that commend it for certain indoor uses. On account of its elasticity, combined with its practically non-absorbent character, it is said to be specially adapted as a floor veneering for markets, butcher shops, saloons, etc.

It may be laid without joints, says Cement World, in a continuous layer one and one half inches deep, upon paper spread over the floor that is being treated. In such case the customary proportions for mixing are 1 part cement, 2 sand, and 2½ sawdust. A great proportion of sawdust would make it too absorbent.

A novel application of sawdust concrete has recently been made in the New Public Library Building in Springfield, Mass. It was employed there as a base on which to lay the cork carpet covering the floors. The object was to obtain a layer into which nails could be driven and which at the same time would hold the nails.

The company that laid it states that it accomplished both purposes. After several experiments with different mixtures it was found that a 1:2 3-4 mix—three-fourths of a part of sawdust—gave the desired result; and 5000 sq. ft. of the mixture was laid. The thickness of the layer was 1 in., and after 4 months of service indications are that the material is a success.

RIMS OF MOTOR CAR wheels, even if they are well coated with japan, will, in time, be attacked by rust, and, as the makers of tires are wont to say, rust is the bane of the fabric. In the owner's garage it is scarcely to be expected that facilities will be available for use in baking on japan. Fortunate, it is possible to cope with this problem, inasmuch as beeswax combines with rust and forms a new compound which prevents the further formation of rust. This same beeswax serves very well as a substitute for properly applied japan, and it may be easily put on, first heating the rim by means of a blow torch. When the rim is heated sufficiently the beeswax may be spread over the rusted surfaces.—Gas Power.

STEAM TURBINE FOR NON-CONDENSING AND BACK PRESSURE SERVICE

FOR back pressure service, that is, where the exhaust steam is to be utilized for heating or drying or other commercial purposes, because of the entire absence of oil in the exhaust, and the absence of pulsations and vibrations, the steam turbine is an ideal prime mover. But commercial turbines have exhibited decided limitations in this service since the steam consumption has always been excessive so that where heating is required only during certain months of the year, the great waste of steam during the warm season has about overbalanced the advantage gained by the double utilization of the steam during the heating season.

Aside from the leakage in the high-pressure stages of the reaction type of turbine, this limitation has been based in the case of turbines of other types, largely upon experience with turbines built up of large wheels originally intended for condensing service. The loss of power from the friction of a disk running at constant peripheral speed increases as the square of the diameter of the disk and also as the density of the steam, therefore in dense steam, as small wheels should be used as is consistent with the flow area necessary to develop the power desired.

With a given steam velocity and with the proper bucket velocity, that is moving about one-half as fast as the steam in impulse turbines, small disks lead to high speeds of rotation, which are unsuitable for driving machinery directly connected. To overcome the speed difficulty, turbine designers have used the standard large wheels employed in condensing work, or have introduced a large number of stages.

The DeLaval Steam Turbine Co., which has always used gears in connection with its single-stage turbine, has recently introduced helical speed reducing gears for multistage steam turbines of large size. When using the gear, the size of the disks may of course be reduced to the minimum, and at the same time, the driven machine may be run at any speed desired. It is therefore perfectly feasible to use the turbine for driving direct-current generators of standard design and at the usual generator speeds.

The "multicellular" type of turbine has been adopted and its general arrangement is shown in the accompanying cross section, Fig. 2. It consists in reality of a series of single-stage impulse turbines like the DeLaval single-stage turbine, mounted upon one shaft, the steam being led from one cell to another in series. This construction offers little opportunity for leakage of the steam while the steam velocities are comparatively low. Because of the stiff shaft employed in the present turbine and the large packing used where the shaft passes through the diaphragms, leakage from cell to cell is small.

A turbine of this type installed in a cloth finishing establishment in New England was originally put in to help out during the dry season, and the steam required for washing, finishing, bleaching and drying operations was taken at such times through reducing valves. Eventually, however, it was seen that it would be more economical to allow the turbine to run continuously, supplying the steam required for manufacturing operations, and to shut down the older engine, which was operated condensing and the exhaust of which was therefore lost. This consideration was still further reinforced by the fact that the turbine showed a high thermodynamic efficiency, realizing some 70 per cent of the total work available between boiler pressure and the back pressure in the exhaust line.

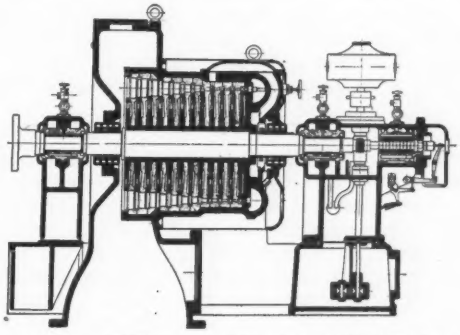


FIG. 2. AXIAL SECTION OF DELAVAL MULTISTAGE STEAM TURBINE, SHOWING GENERAL ARRANGEMENT

This exceptionally good performance is due both to the small wheels and the high speed used, and also to the close clearances between shaft and diaphragms made possible by a comparatively small number of wheels and a stiff, rigid shaft. The turbine runs at 3600 r.p.m. and drives a 4-kw. Crocker-Wheeler generator at 600 r.p.m., generating current at 250 volts.

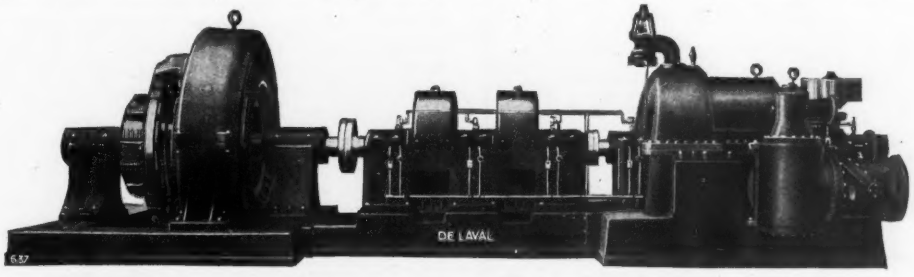


FIG. 1. DELAVAL MULTISTAGE GEARED TURBINE, NON-CONDENSING TYPE, DRIVING DIRECT-CURRENT GENERATOR

Information from which this article is prepared has been supplied by the DeLaval Steam Turbine Co., Trenton, N. J., the manufacturers of the turbine, to whom we are also indebted for the illustrations.

MOVING PICTURES are to be used by the Central Georgia Railroad to teach the elements of railroading to the more ignorant of the employes, many of whom are illiterate. It is believed that by substituting pictures for textbooks they can be taught to perform their duties more intelligently. Almost every detail of train operation can be shown effectively on the screen, and the pictures can be run over as many times as may be needed to teach the processes thoroughly.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

TRANSFORMER CONNECTIONS

Various Possible Combinations of Transformers for Single, Two and Three-Phase Systems

ALTERNATING-CURRENT systems of distribution are now extensively used, practically to the exclusion of direct-current systems where any considerable distance is covered. The flexibility of such a system makes it possible to transmit power at high voltage which can be stepped down with small loss by means of the transformer.

In Fig. 1, A represents a single-phase transformer connected to a single-phase transmission line; the primary winding is indicated by P and the secondary winding by S. The ratio of transformation, that is, the ratio of primary to secondary voltage is not arbitrary, as standard transformers are made with various voltage combinations, but any ratio may be had by special windings. Where the load exceeds the capacity of a single transformer, a second transformer may be connected in multiple with it as shown at B in Fig.

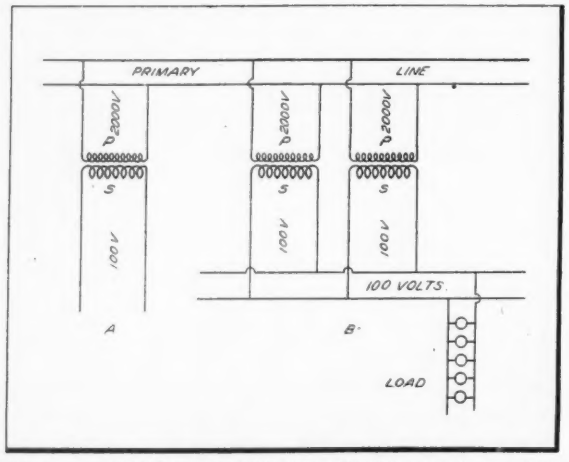


FIG. 1. A. SINGLE TRANSFORMER CONNECTED TO A SINGLE-PHASE ALTERNATING CURRENT CIRCUIT. B. TWO SINGLE-PHASE TRANSFORMERS CONNECTED IN MULTIPLE ON SINGLE-PHASE PRIMARY AND SECONDARY CIRCUITS

1, or if the load increases beyond the capacity of the 2 transformers a third may be added. It is preferable, however, to use one large transformer in place of several small ones, thereby increasing the efficiency of transformation; furthermore, if the transformers do not have the same voltage regulation, the load may divide unequally between them and one take more than its share. The result would be that the fuses of the heavily loaded transformer would "blow" throwing an additional load on the remaining transformers and in turn "blow" their fuses.

Modern transformers are generally made with their primary and secondary windings in 2 sections as shown in Fig. 2, by means of which subdivision a greater flexibility is obtained. The 2 sections of the primary and the secondary windings may be connected in series as shown at A, Fig. 2, adapting the transformer to 2000-100 transformation or, where a low voltage and a large current are needed, the secondary windings may be connected in multiple as shown at B Fig. 2, giving a transformation of 2000-50.

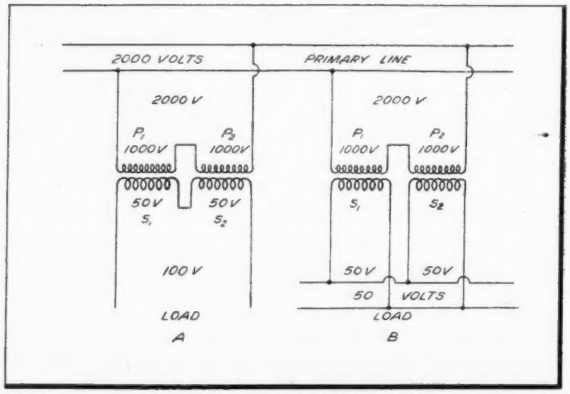


FIG. 2. A. SINGLE-PHASE TRANSFORMERS WITH SUBDIVIDED PRIMARY AND SECONDARY WINDINGS. B. SAME TYPE OF TRANSFORMER WITH PRIMARY SECTION CONNECTED IN SERIES AND SECONDARY SECTION IN MULTIPLE

Conversely the primary windings may be connected in multiple and the secondary windings in series as shown at A in Fig. 3. B shows the arrangement of connections, for 3-wire secondary distribution.

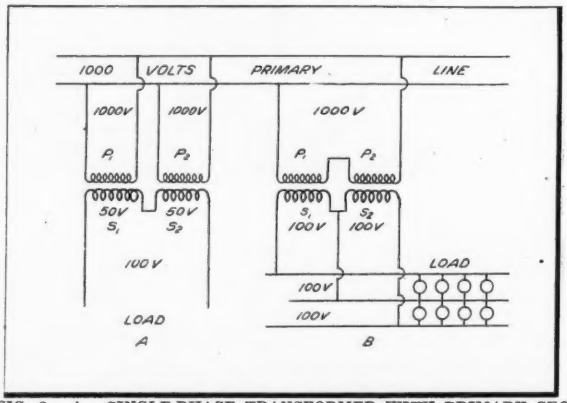


FIG. 3. A. SINGLE-PHASE TRANSFORMER WITH PRIMARY SECTIONS IN MULTIPLE AND SECONDARY SECTION IN SERIES. B. ARRANGEMENT OF CONNECTIONS FOR THREE-WIRE SECONDARY DISTRIBUTION

Two-phase Systems

THE majority of 2-phase circuits are 4 wire; such a system is practically equivalent to 2 single-phase circuits and utilizes 2 single-phase transformers as shown at A Fig. 4.

In connecting transformers to 2-phase systems, the aim should be to have the load on the 2 phases as

nearly balanced as possible. Both phases are used for the operation of induction motors, consequently there is little or no danger of an unequal load division. When the load is principally lights, one transformer or a set of transformers can generally be balanced against another group located at some other point.

Two and Three-Phase Transformation

WINDINGS and grouping of transformers must be adapted to each particular case. In Fig. 4, B shows an arrangement whereby 2-phase currents may be converted into 3-phase currents or vice-versa. Two transformers are required, one having its primary and

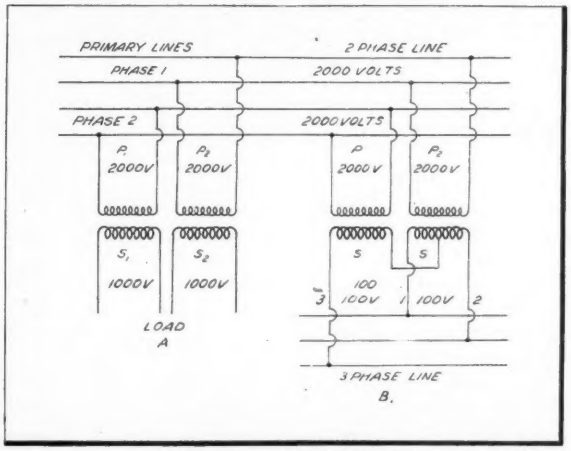


FIG. 4. A. TWO-PHASE TRANSFORMATION. B. 2-PHASE-3-PHASE TRANSFORMATION

secondary windings in relation of 1 to 1 and the other in a relation of 1 to 0.86. The secondary winding of the 1 to 1 transformers is tapped at its middle point and joined to one terminal of the other secondary winding. Between any pair of the 3 remaining terminals of the secondaries a uniform potential exists.

Three-phase Transformation

THERE are 2 general methods of connecting transformers for 3-phase transformation, the delta shown at A and the star shown at B in Fig. 5. In some cases the transformers are connected across the

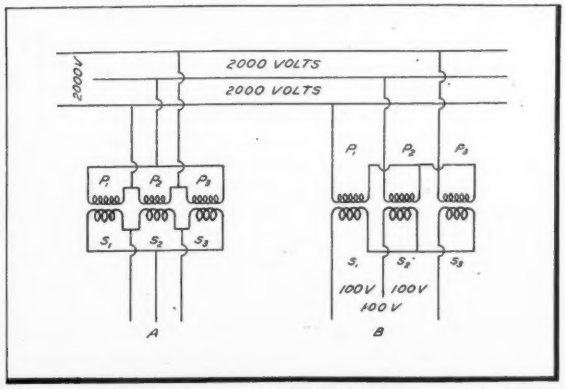


FIG. 5. A. THREE-PHASE TRANSFORMATION, DELTA CONNECTION. B. STAR OR Y CONNECTIONS

line according to the star system, and since there are 2 primary coils in series between any pair of mains, the e.m.f. across any individual coil is less than that across one phase. The choice between these 2 methods is determined largely by the service requirements.

When 3 transformers are delta-connected one may be removed without interrupting the service of the circuit, the 2 remaining transformers each carrying a part of the load of the missing transformer.

This feature of being able to avoid a shut-down from the disabling of one transformer has led to the extensive use of the delta connection, especially on the low-potential delivery side.

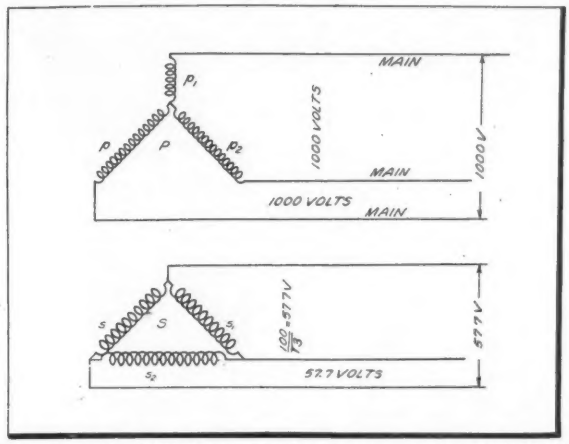


FIG. 6. STAR-CONNECTED PRIMARY AND DELTA-CONNECTED SECONDARY WINDINGS

A change from delta connection in the primary to star in the secondary circuit alters the ratio of transformation and makes the secondary electromotive force 1.732 times the value it would have with delta connections of both windings. Changing from delta to star at the primary terminals increases the transformation ratio and reduces the potential on each primary winding. When the voltage of a transmission circuit is so high that the successful insulation of the transformer coils becomes of constructive importance, the three-phase line sides of the transformers are fre-

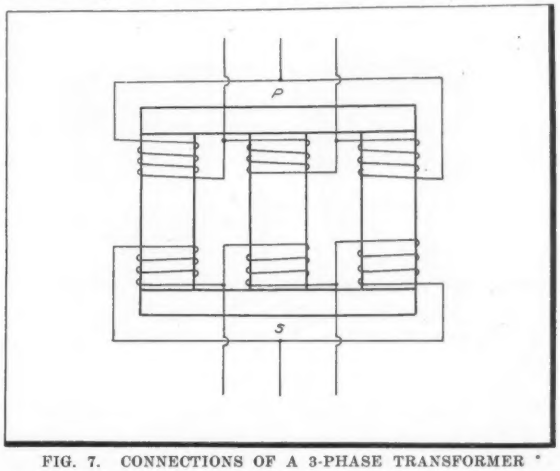


FIG. 7. CONNECTIONS OF A 3-PHASE TRANSFORMER

quently connected in star. Figure 6 shows a star to delta transformation.

Three-phase Transformers

A SPECIAL transformer known as a polyphase or 3-phase transformer is also largely used. This is shown in diagram in Fig. 7. The polyphase transformer is in reality several one-phase transformers with distinct electrical circuits but with a common magnetic circuit, and can be connected in any combination that it is possible to connect 3 separate single-phase transformers.

For supplying power to motors operating on 3-phase circuits, it is often more desirable to use a 3-phase transformer than 3 single-phase transformers. In the case of a 3-phase transformer, the losses and

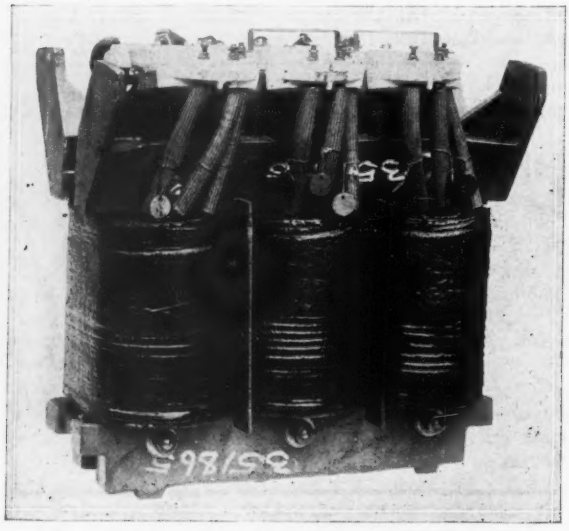


FIG. 8. THREE-PHASE TRANSFORMER WITHOUT CASE

weight as well as the space occupied, are generally somewhat less than those of 3 single-phase transformers of the same aggregate capacity. Furthermore, the fact that the 3-phase transformer is contained in one case and has only 6 leads altogether as compared with 3 separate transformers having not less than 12 leads, renders the installation and wiring considerably easier. It also presents a much neater appearance on the pole than an installation of 3 transformers.

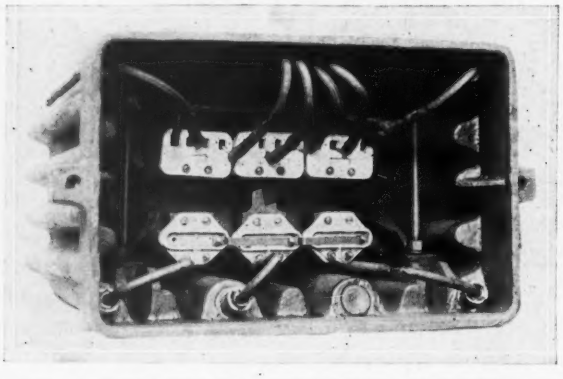


FIG. 9. CONNECTION BLOCK OF 3-PHASE TRANSFORMER

A 3-phase transformer consists primarily of three single-phase windings mounted on one core composed of 3 separate legs and contained in one case. The coils of the 3 phases are interconnected so that only 3 leads each are brought out of the case for the primary and secondary connections.

Figures 8 and 9 show respectively, the transformer without case and the connecting block.

Transformers for Rotary Converters

WHEN synchronous converters are employed for supplying power to lighting circuits, it is frequently desirable that a lead at neutral potential be run on the direct current side of the system. Since the input side of the converter is electrically connected to the output side, it follows that the alternating-current end of the converter is simultaneously the neutral point on the direct-current end. For this reason it is sometimes desirable to join the low potential windings of the transformer in such a manner as to permit an electrical connection to the neutral conductor of the 3-wire direct-current system, for which the star connection is advantageous, providing the high-potential primary windings are delta-connected; but the delta connection cannot be used for secondary circuits.

EXPERIENCES ON THE ROAD

Difficulty Encountered in Paralleling Exciters

By Leonard Work

WHEN exciter generators are to be controlled by a Tirrill voltage regulator, it is necessary, in order to secure an equal division of load when operating in parallel, that their regulation characteristics be similar. Compound-wound exciters of diverse capacities and of various makes, are apt to show different regulation characteristics, and satisfactory parallel operation requires that such differences be harmonized. This is usually accomplished by adjusting the compounding of the machines, the amount of adjustment required being indicated from curves of voltage variation obtained under different loads.

Instances now and then arise where considerable difficulty is encountered in making 2 or more generators parallel properly, and where no amount of alteration of compounding or adjustment of the auxiliary rheostat supplied in voltage regulator installations is able to bring about the desired result. A noteworthy case of this kind occurred recently where a voltage-reguator was installed to control 2 22.5-kw. compound-wound exciters. Both were of the same size and make, and apparently were exact duplicates. When these machines were connected to the regulator and in parallel under an equally divided load, the division being effected by auxiliary rheostat adjustment, any increase of load called for by the regulator invariably caused No. 2 exciter to take the increase and No. 1 to lose a small amount of load. This seemed to indicate beyond all doubt an excess of compounding on No. 2, or a lack of it on No. 1, notwithstanding the fact that the regulation curves of the exciters were similar.

In this plant the voltage requirements were such that the series windings on the machines could not, as a probable means of removing the trouble, be dispensed with. It was therefore decided to decrease the compounding of No. 2 exciter. This was not done by shortening the shunt across the series winding but by introducting resistance in series with the series winding, inside the shunt connection. Incidentally it may be mentioned that a point often overlooked in the adjustment of direct-current machines for parallel operation, is that an alteration of the shunt of one machine also affects the machine with which it is coupled, since, owing to the presence of the equalizer, the resistance shunts and the series windings of both machines are all in parallel. Therefore, to decrease the compounding of one of a pair of generators by shortening its shunt is similarly to decrease the compounding of the other. In cases where it has been particularly difficult to make the regulation of 2 machines similar, success has been obtained only by the introduction of resistance, in series with the series-winding of the one having the greater compounding, inside its shunt, thus decreasing the current in the series coils.

After the addition of resistance to the series windings of this generator, its compounding was observed to be greatly reduced, and a resetting of the auxiliary rheostat was required to balance the loads. However, contrary to all predictions, upon a demand for more current at the exciter busbars, No. 2 still manifested as strong a tendency as ever to monoplize the load. A further reduction in the compounding of this machine availed nothing. This paradoxical result was hardly anticipated but obviously indicated the futility of any further pursuit along these lines.

Attention was next directed to tightening up uncertain contacts in the equalizer connections and to securing an accurate brush setting, which on No. 2 generator was found to be considerably behind the neutral. These latter adjustments caused a slight improvement in the conditions. No. 1 exciter instead of losing current as formerly, upon an increase of busbar load was now very reluctantly inclined to follow the lead of its companion.

The conditions at this stage were as follows: Starting with 50 amp. on each exciter, if an increase in load caused No. 2 to assume 90 amp. No. 1 took only 60. If a light load caused No. 2 to drop to 10, No. 1 would still have 40 amperes. It was clear that when No. 1 machine was given a certain load it was loath to part with it or to accept more while in parallel with the more sensitive unit. It was apparently very sluggish or slow to respond to variations of its own field current. The saturation curve of the sluggish machine showed that it required a considerable variation of the field current to lower or raise the voltage at any point on the curve.

The trail of investigation now turned to the air-gaps of the generators in question and disclosed the fact that the clearance between armature and field poles was much less in one of the machines than in the other. The matter was soon remedied by changing the air-gap by readjustment of liners. After this adjustment was completed the machines were again started up and each machine found to operate properly when running alone. The machines were again connected in parallel and under control of the regulator. A few minutes observation sufficed to prove that the trouble had been eliminated. The No. 1 machine indicated through its ammeter its responsiveness to all load variations, the difference in load between the 2 being so slight as to be negligible.—The Electric Journal.

STEEL WHICH HAS BEEN rusted can be cleaned by brushing with a paste compound of ½ oz. cyanide potassium, ½ oz. castile soap, 1 oz. whiting, and water sufficient to form a paste. The steel should be washed with a solution of ½ oz. cyanide potassium in 2 oz. water.

AN IDEA OF THE SERVICE that the United States Geological Survey is doing the country in conserving coal and oil supplies is gained from the fact that the total area of coal land which has been classified and valued in 40 acre tracts is estimated at 17,400,000 acres, valued at $721,850,000. If this land had not so been classified the value would have been only $275,670,000, a saving to the people of over $446,000,000. Coal lands withdrawn from homesteading because of the geological evidence of coal deposits amounts to about 69,000,000 acres. Oil lands have been withdrawn amounting to 4,770,000 acres, phosvaluable water power may be developed over 2,000,000 phate lands of over 3,000,000 acres and power sites where acres.

PRACTICAL ELECTRICAL ENGINEERING

Ohm's Law and How it is Applied; the Volt, Ampere and Ohm; Definitions

THERE are 3 fundamental units that enter into all calculations of electric circuits, the volt, the ampere and the ohm. They all bear a definite relation to each other as expressed in Ohm's law. The following examples will show how the law is applied to practical problems.

In a circuit whose voltage is 110, is connected a resistance coil with a resistance of 50 ohms. What is the current flowing through it?

This is determined by Ohm's Law which gives the definite relation between voltage, current and resistance and is expressed by the formula I=E÷R. Where I is the current in amperes, E the voltage and R the resistance. We would then have I=110÷50=2.2 amperes, the current flowing through the resistance.

If 20 110-volt, 16-c.p. incandescent lamps with a resistance of 220 ohms each were connected in series on a circuit with a voltage of 2200, what current in amperes would be required? Total resistance of lamps would be 220×20=4400 ohms, then amperes would equal 2200÷4400=0.5.

A magnet is wound with 1000 ft. of No. 20 copper wire and has a resistance of 10 ohms. If connected to a circuit with an electromotive force of 10 volts what current would flow through the wire? Volts divided by resistance, 10 ÷10 =1 ampere. Ans.

In these examples voltage and resistance have been given to find the current. There are many problems where it is required to find the resistance when the current and voltage are known. The law for such problems is expressed in the formula R=E÷I or resistance equals volts divided by amperes.

A 110 volt generator delivers a current of 100 amperes to the switchboard 100 ft. distant. What size of wire will be required so that there will be a loss of but one volt between the generator and board?

R=1÷100=.01=required resistance.

By referring to a wire table it will be found that a No. 0 wire is nearest the required size.

If the current flowing through a circuit and its resistance are known the voltage can be determined by the following formula E=I×R.

What voltage will be required to cause a current of 10 amperes to flow through an electromagnet having a resistance of 11 ohms? 10×11=110=voltage.

A circuit contains 1000 ft. of wire and its resistance is 257 ohms. What electromotive force is required to maintain a current of 10 amperes in the circuit? 257 ×10=2570 volts. Ans.

We have seen that Ohms law expresses the relation in an active electric circuit of current, electromotive force and resistance. These 3 factors are always present in such a circuit. Its general statement is as follows:

In an active electric circuit the current is equal to the electromotive force divided by the resistance.

This law may be expressed in various ways as it is transposed. It may be given as a group of rules to be referred to under the general title of Ohm's Law.

Rule 1. The current is equal to the electromotive force divided by the resistance.

Rule 2. The electromotive force is equal to the current multiplied by the resistance.

Rule 3. The resistance is equal to the electromotive force divided by the current.

Rule 4. The current varies directly with the electromotive force and inversely with the resistance.

Rule 5. The resistance varies directly with the electromotive force and inversely with the current.

Rule 6. The electromotive force varies directly with the current and with the resistance.

The 3 fundamental units, the volt, ampere and ohm may be defined as follows:

The volt is the pressure necessary to cause a current of one ampere to flow through a resistance of one ohm. The ampere defined practically is the current required to operate 2 ordinary 16 c.p. 110 carbon filament incandescent lamps. The ohm is the unit of resistance and as a practical illustration 2 3/10 ft. of No. 36, 380 ft. of No. 14 and 961 ft. of No. 10 wire, each have a resistance of one ohm.

SYNCHRONOUS BOOSTER ROTARY CONVERTERS

Special Construction Whereby a Wide Range of Direct Current Voltage Can be Secured

RATIO between the alternating and direct current voltages of a given elementary rotary converter is a nearly fixed quantity which remains constant, within a few per cent from no load to full load. Some addition to the ordinary converter or some auxiliary apparatus is necessary to obtain a variable direct current voltage. The important commercial methods of obtaining a variable direct current voltage are:

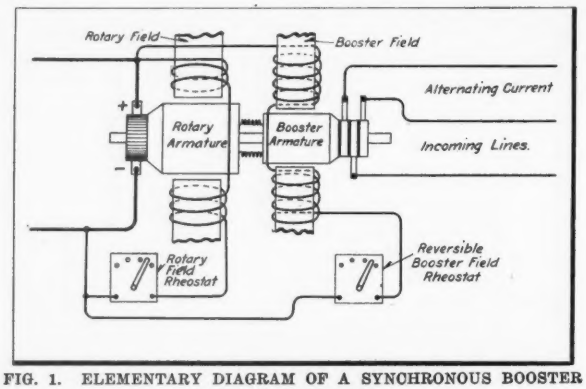


FIG. 1. ELEMENTARY DIAGRAM OF A SYNCHRONOUS BOOSTER ROTARY CONVERTER

With an alternating-current synchronous booster; with an alternating-current potential regulator or regulating transformer; with a direct-current booster; with a split-pole converter; by automatic compounding. All of these methods have been applied with more or less success. The synchronous booster method is now being advocated by the Westinghouse Electric & Manufacturing Company for certain applications, and is being used so extensively that an explanation of the principles and of the construction of the synchronous booster rotary converter is of timely interest.

Synchronous booster converters consist of a rotary converter having on its shaft the armature of an alternating current generator which has the same number of field poles as the converter. It is really an alternating-current booster converter. The generator armature windings are connected in series with the taps between the collector rings and the converter armature winding.

Voltage Control

BY varying the field excitation of this alternating current generator, the alternating current voltage impressed on the rotary converter proper can be increased or decreased as desired. The direct current voltage delivered by the converter is thereby varied accordingly. The principle of operation of the booster converter is, therefore, simple and easily understood. The machine is simply a combination of 2 standard and thoroughly tried-out pieces of electrical apparatus.

By means of a reversing switch in the field circuit, the polarity may be reversed without opening the booster field circuit and the generated voltage made to increase or decrease the voltage impressed at the collector rings. The alternating current voltage applied to the converter armature winding may be varied, therefore, over a range equal to twice the voltage range of the direct connected generator, and the direct current voltage delivered by the converter varies in pro-

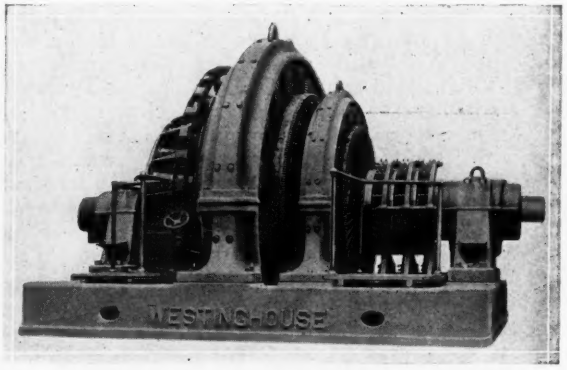


FIG. 2. SYNCHRONOUS BOOSTER ROTARY CONVERTER MANUFACTURED BY WESTINGHOUSE ELECTRIC & MFG. CO.

portion. The converter field current must be varied as the alternating-current voltage applied varies, in order to maintain a 100 per cent power factor input.

While the normal voltage for a converter of this type is midway between the extremes of its range; i.e., the voltage developed by the converter when the booster field is not excited, the fact that it may be operated over a considerable range of voltage makes it, in general, a somewhat larger machine than the simple converter. This increase in size is necessary to prevent excessive saturation of the iron at the maximum voltage and so that the commutation will be good at the minimum voltage.

The inherent construction of the booster generator, which involves a narrow multiple path armature, is ideal for low voltage generator. Due to the fact that this generator is mounted on the shaft between the collector rings and the rotary armature, the desired result is attained with a minimum increase of weight, space and cost.

Any standard Westinghouse rotary converter can be used as part of the combined booster converter unit. Synchronous booster rotaries can, therefore, be provided of any standard capacity, phase, voltage or frequency. They are usually furnished, however, for 250 volt, six phase circuits.

The voltage variation can be made any desired, by properly proportioning the boosting generator capacity. For extreme voltage ranges special rotary converters are required. The usual variation is a total range of 30 per cent; that is, 15 per cent below and 15 per cent above the average voltage for which the

rotary converter is designed. This range is obtained by a boosting generator with a capacity of 15 per cent of that of the rotary converter.

Synchronous booster rotary converters are well adapted for any application for which a relatively wide variation, either automatic or non-automatic, direct current voltage is required. They are particularly desirable for serving incandescent lighting systems where considerable voltage variation is necessary for the compensation of drop in long feeders, for operation in parallel with storage batteries, and for electrolytic work where extreme variations in voltage are imperative because of changes in the resistance of the electrolytic cells; for 3-wire service synchronous booster converters can be used in the same way as are standard converters.

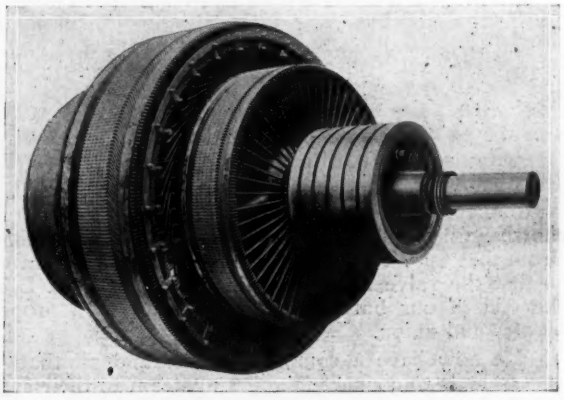


FIG. 3. ARMATURE OF SYNCHRONOUS BOOSTER ROTARY CONVERTER

Starting may be effected by any of the methods applicable to ordinary rotary converters, viz.: alternating current or direct current self-starting or motor starting. The alternating current, self-starting method is standard with the Westinghouse Company.

Since the synchronous booster converter is simply the combination of a standard rotary converter and an alternating current generator of a standard form, there are incorporated in it no details of construction essentially different from those encountered in apparatus of these two classes. The only novelty is in their combination.

BILL AND HIS GROUCH

By Walter H. Dunn

MY engineer friend Bill has charge of 2 26 by 48-in. improved Greene engines which are direct-connected to a 300-kw. 545-amp. generator. One bright spring morning he tramped into our engine room looking worried and with his mouth so far down that he was treading on his mustache.

"Good morning, Bill," says I, "What's the matter with your great long face?"

"Huh," says he, with a grouch.

"Well, what's up now," says I. "Have you lost at bucking the tiger or hasn't the last copy of Practical Engineer showed up?"

"Here," shoving his hand at me in which he held the diagram, No. 1, "What d'you make out of that?"

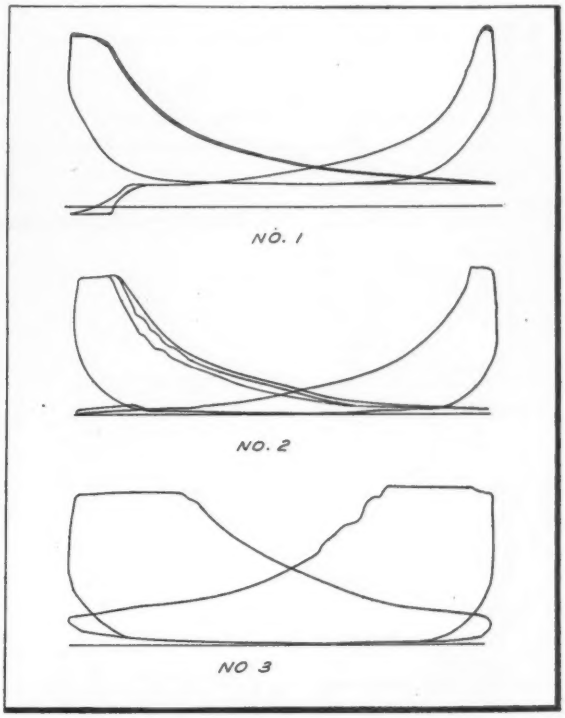
"I make a daily paper puzzle. Find the path the burglar took," says I. "How did you do it?"

"Oh," says he, "Something's gone wrong with that engine of mine somewhere and every time the load goes off there is an awful clicking in the cylinder. I want you to read that card for me."

"I never studied Chinese but I can read a laundry ticket as well as I could that diagram. Expansion looks right, compression looks right, what's the matter with your back pressure? There must be a hole in your exhaust pipe somewhere," was all the comment I could make.

"That doesn't help me any," said Bill, "and you better come up and look her over."

So after I ran out my trick I went up to take a look and in a short time I found where the trouble was with the diagram. The pencil mechanism of the indicator was all adrift and I could lift it ¼ in., when it would drop of its own accord.



BEFORE AND AFTER DIAGRAMS

I took it down and looked it over and found that Bill had put the spring into the indicator wrong way to. When he was putting the indicator together he unscrewed the piston from the rod, then put the spring over the rod and put the piston on, leaving about ⅛ in. between the socket of the piston and the bottom of the channel of the rod—and the directions were right in front of him all the time.

I put the indicator together right and took diagrams, Nos. 2 and 3, No. 2 with a light load and No. 3 at about its rated capacity, so it was plain that there was no serious trouble in the cylinder.

But Bill said, "I want that miserable clicking out of there."

So Thursday afternoon we got at it and took off the cylinder head. The piston was in line and well lubricated. Everything looked all right but I renewed 6 of the coil springs that held the expansion packing rings out, and we put her back. That was all she needed and now she runs fine as silk, and I left Bill wearing his 8-in. smile again.

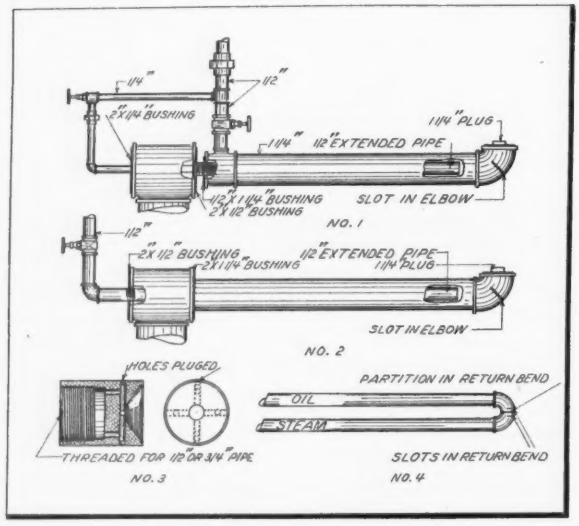
LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

BURNING OIL

IN reply to our friend's question, "How to Burn Oil," I will give a few hints in regard to burners used here in the California oil fields where the oil is from 30 deg. to 14 deg. Baume. Most of that used for firing is about 14 deg., which means use plenty of steam in your fuel tank heater, as when the oil is cold you can almost cut it with a knife.

As to the burners, they can most all be made from a few pipe fittings, and if made with care will give excellent results. Those shown in Figs. 1 and 2 are automatic in action and will hold the steam for hours at a time with only a few lb. variation. No. 1 consists of the fittings indicated in the drawing and is made as follows:



TYPES OF OIL BURNERS

Take a 1¼-in. L and saw a slot so that it will form an angle of 45 deg. with runs of the L. Take care to make the slot square with the run and saw it just a shade less than half way through. I find that by putting 3 hack saw blades in the frame at once it gives a slot of good width, which should be finished up with a small file to make it a good smooth nozzle. Now take a piece of 1¼-in. pipe of sufficient length to have L about a foot inside the firebox and leave enough outside for handy connections (2 ft. is about right); now take a 1¼-in. T and make it up so that its center run looks up and the slot in the L down. Next take a piece of ½-in. pipe and cut a running thread long enough to take first a 1¼ by ½-in. and second a ½ by 2-in. bushing back to back. Now allow for the make up of the bushing in the T and cut off the ½-in. pipe to such length that when made up its end will be 4 in. from the slot in the L.

All small pipes should be cut off with a hack saw to avoid burrs and reduced size, as is the case when cut with a roller cutter. Next take a 2-in. T and make up a nipple, a valve, a nipple and a union in the cross run of the T, then take a 2 by ¼-in. bush and make up a piece of ¼-in. pipe with sufficient running thread to take an L after passing through the bushing. Allow for the make up of thread in T to the rest of the burner and for thread on bushing, then cut off ¼ pipe so that when made up it will extend about ¼ to ⅜ in. into the ½-in. pipe; the end of the ¼-in. pipe should be filed or ground to a thin nozzle so as not to restrict the area of the ½-in. pipe more than is necessary.

Connect a ½-in. steam line to the 1¼-in. T as shown with nipple, valve, nipple, T, nipple and union. From the ½-in. T run a ¼-in. pipe with an angle valve so that the valve will fall in line with our ¼-in. L in the end of our burner and connect up with proper nipples and union.

We now have a complete burner and all that is necessary is to connect the oil and steam to their supply lines.

Its action is as follows: Oil entering the 2-in. T flows through the ½-in. pipe, which is surrounded by steam, and when they unite they do the "loop the loop" and come out through the slot in a spray that is perfectly willing to burn if your steam is throttled right. The oil valve is run wide open after steam is up and the steam throttled so that the pressure in the burner holds the oil back and it will only send along once in a while a little slug of oil, just to keep the flame from going out. When the steam drops a little the pressure is relieved on the oil, it then flows steadily until pressure cuts it down. The ¼ connections are seldom used except when it is desired to force the fire, then the angle valve is regulated to act as an injector and force oil through the ½-in. pipe.

In connecting the burner it is a good plan to bring your steam line down at one side of the boiler and then run across to the burner, putting in a throttle at one side of the furnace door, then when the burner valves are once adjusted they can stay so, as the steam is shut off by a separate valve. When relighting a fire in a hot furnace, if you are standing in front of the door and happen to shut the steam off a little too much, when you turn it on again you are liable to find yourself pawing around in a cloud of smoke and fire and wondering what hit you.

Burner No. 2 is similar except that the forced feed is left out; the 1¼-in. pipe screws directly into the 2-in. T and carries the oil, while the ½-in. pipe is 4 in. from slot in the L, extends back through the T and carries the steam.

Burner No. 3 is a forced feed and must be made in a lathe. Take a piece of brass rod of sufficient diameter to be bored out for ½ or ¾-in. pipe, according to size wanted. I think the drawing will clearly explain its construction, except that the cross passages are drilled

clear through the burner and then the ends plugged. This burner is connected with 2 lines by a Y or a T.

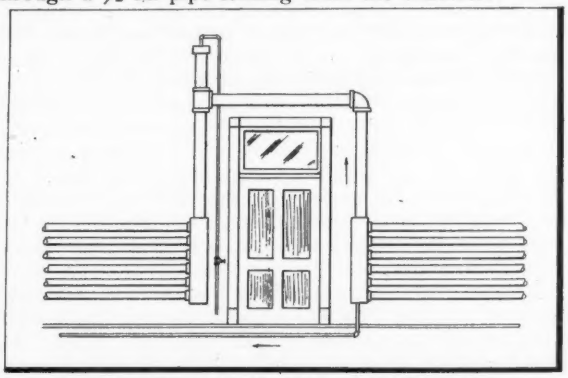
Burner No. 4 may be used on either a gravity or a forced feed and is made, as shown, from a return bend by putting a partition in the middle and sawing a slot on each side of it for oil and steam. The steam slot should be given a slight upward angle, so as to meet the oil as soon as possible.

This burner was used in a plant where I was some time ago under Sterling boilers, but was later replaced by No. 3, which gave better satisfaction. Nos. 1 and 2 are for gravity burners only.

Jas. A. McBain.

AIR CHAMBER FOR WALL COIL

MANIFOLD wall coils are especially adapted for greenhouse heating. To permit the escape of air from the heating coils, an air chamber may be placed at the highest point in the system and the air exhausted through a ½-in. pipe leading from the chamber.



METHOD OF VENTING COIL IN GREENHOUSE

The illustration shows the arrangement of the piping and location of the chamber over a doorway. When the coil becomes airbound the valve in the ½-in. pipe is opened, permitting the escape of any accumulation of air in the chamber. Lewis A. Danner.

LUBRICATING WITH WATER

QUITE an interesting story, that by Joe Bush in the June 15 issue of the paper, "A Lesson in Cheap Lubrication." Isn't it strange that no one thought of the water scheme to keep the bearings cool, when water has been used for that purpose—both on land and marine engines—from away back? It is almost as "old as the hills." Of course water is not as good lubricant as oil, but it is a good thing to carry off the heat generated in a bearing.

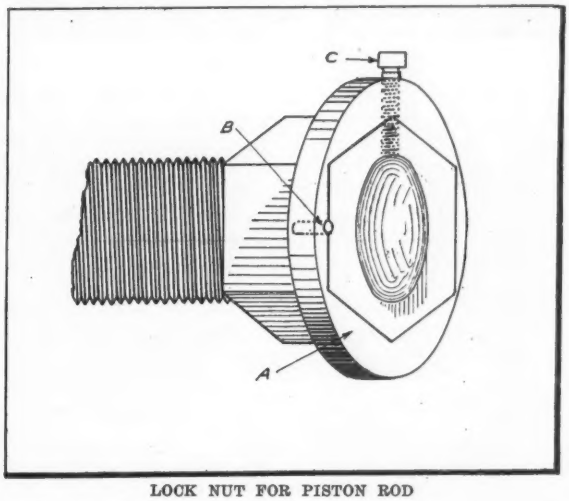
Using water instead of oil or grease means that more steam will be required to do a certain work. But, if oil or grease, or a combination of both, fail to keep the bearings cool, then water should be used as told in Mr. Bush's story.

With marine engines we used water on the main bearings, crankpins, and eccentric straps, and on the thrust bearing. But we also used an oil that would saponify when mixed with the water, and the engineers and oilers were happy when the "lather" showed at the sides of the bearings on which the water was applied, for that was a sure sign that everything was all right as far as keeping cool is concerned.

But whenever the latter ceased to come out, we looked for trouble, and found it in time to prevent injury and delay. The lather would not form on a hot bearing. Of course there are some marine engines that do not require water, but even those are equipped with a "water service" in case of need. When water is used, it is usually shut off a few minutes before the engine stops for good, so as to leave nothing but a coating of oil on the bearing surfaces. A little of that kind of oil would have improved the running of the crusher in the story. Charles J. Mason.

ADJUSTING AND SECURING LOOSE PISTON ROD

IN regard to the case mentioned by "Student" in Practical Engineer of June 1 the only thing to do would be to shut down the engine, and screw in the piston rod, giving the proper clearance. By some engine builders this clearance is marked on the guides. In case it is not marked it can be determined by setting the engine on dead centers, and scribing marks on the guides, in line with the edge of the crosshead. Then take out the crosshead pin, and push the piston until it strikes against the front head. Measure the distance the edge of the crosshead has traveled beyond the travel mark. Now bring the piston back, until it strikes the back head, and measure the distance the crosshead has traveled beyond the travel mark. All to be done now is to equalize the distance beyond the travel marks on both ends.



LOCK NUT FOR PISTON ROD

If the piston rod is not a snug fit in the crosshead, it is liable to work loose. I ran across an engine a short time ago, which gave trouble in this respect. The rod had to be screwed up a little, every week or so. My advice, being asked about the remedy, was that a new piston rod should be fitted to the crosshead, after the latter had been chased out. This was done. When the crosshead was taken out, it was found to be so badly worn in the threads, that it seemed to be a miracle that it had not pulled out and wrecked the engine.

A good form of lock nut is shown here; it is of steel, threaded and counterbored in order to slip up over the rod covering the thread. The steel ring A, carrying the dowel pin B, is fitted, on one end, to move freely. A hole is drilled into the end of the crosshead, the pin B slips into it, and the jam nut is set up tight and locked in place with the set screw C, which is threaded through A, and bears on the end of the nut. This nut will prevent the rod from loosening and backing out of the crosshead; as to do so, it would be necessary to shear the pin. Tom Jones.

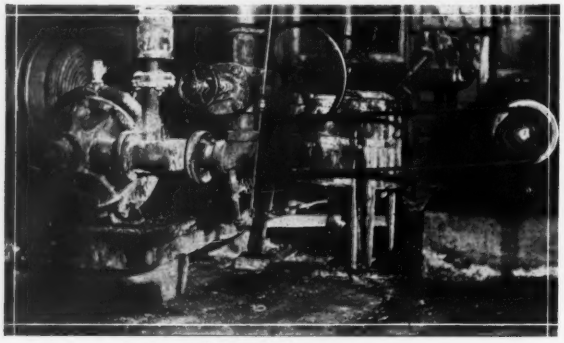
WASHING OVERALLS

I READ with much interest Wm. H. Kuchenbord's article on washing overalls at the plant in the May 1 number of Practical Engineer.

In the plant where I am working we have a washing machine which is belted to the circulating pump on the condenser.

There is a ¼-in. pipe run from the main steam line of the vacuum pump to the bottom of the washer which is used to heat the water, also there is a 1-in. pipe from the washer running out of doors to drain the water from the machine.

We fill the washer about ⅔ full of warm water,



LAUNDRY IN A POWER PLANT

put in some washing powder or caustic soda, then the overalls, or whatever we are washing, cut in a bar of soap, shut down the lid, start the machine, turn on the steam and go sit down and read Practical Engineer or the daily for a half-hour, take the overalls out and rinse in cold water, then put them in the washer and fill about full of cold water and rinse again.

It cost about $9 to install the washer, and it almost paid for itself in 2 months.

We wash our work shirts, socks and under clothes, sometimes blankets, etc. A good size washing can be done for less than 10 cents.

F. W. Donahey.

OIL IN BOILERS

I WOULD like to add a few notes to those in the issue of June 15, regarding oil in boilers and dangerous bags. I have seen numbers of boilers in all parts of the world, and in most cases of what is termed "bagging" or in some cases "blisters," etc., I have found it generally due to oil getting into the boiler. It does not appear to matter whether there is thick scale or no scale at all, it is generally the same trouble—oil. And I have found that vegetable and animal oils are more dangerous than pure mineral oil, and they frequently become exceedingly dangerous when the usual practice of boiling them out with soda or some alkali is resorted to, and improper flushing out usually follows.

There appears to be a wide-spread idea that certain mineral oils may be put into the boiler, and will break down old scale that may be contained therein. It frequently bags the boiler, or sags the tube; and as mineral oil is absolutely unsaponifiable, it is quite useless to attempt to remove it by the use of soda ash or caustic soda. The only safe course to pursue is to prevent any oil whatsoever getting into the boiler.

Mr. Debo was quite right in being uneasy when his boiler contained oil. I have had the unpleasant experience in more than one boiler watching a blister form, and wondering whether the next moment would take me to kingdom come, or not.

I would strongly urge anyone who has boiler plants to look after to eliminate very carefully every trace of oil from the feed water.

Thos. R. Duggan.

DOES OIL CAUSE A BAGGED BOILER?

ALL my life—that is my life as an engineer—I have heard considerable discussion as to oil in boilers, and its ill effects. Almost every month comes news from somebody regarding this subject, and when one is a subscriber to several engineering journals, he gets, in time, more or less curious as to certain things pertaining to the subject. Now comes, in this, your issue of June 15, an article by Wm. Debo, and we are given an illustration, supposed to be the actual shape, etc., of the bag, caused by oil in the boilers, and which prompts me to write this letter, in order that I may not only air my own views on the subject, but to see if anybody can actually prove that oil has caused them all their troubles.

I have always, until recent years, fought oil, of any description, to keep it from my boilers, thinking that it would result in bags, blisters, and perhaps an explosion. I believe it is a fact that oil floats, and so naturally think that all the oil that is in the boiler, will be found on the surface of the water. The water, on being blown out, naturally falls in the boiler shell, and of course the oil naturally falls with it. So that when the boiler is empty, and we knock in the heads, we find a film of oil, sometimes heavier, and sometimes lighter, on the shell and tubes, though I have found that nearly always the shell has more on it than does the tubes, or flues.

I always thought that this oil lay there all the time and so of course would sooner or later cause one lots of trouble. But after thinking the matter over, I came to the conclusion that it was all wrong. So in order to prove my contentions I arranged a large mouthed funnel on the same plan as a skimmer funnel, and cooling down a boiler after I had let the heater go dry, and so got all the oil that was in that into the boiler, and in addition put in one gallon of cylinder, one of engine, and five of common crude oil, I pumped clean water in the bottom of the boiler, and took out, through the funnel and its connecting pipes, all the water from the surface. I kept this up, using lots of water to be sure, until but very little oil came out of my "surface blowoff."

Then I emptied the boiler, and found not a bit of oil on the shell. Strange, isn't it? Yet I will say this, that wherever you may find a boiler skimmer, and it working properly, you need not fear that oil will bag your boiler, for old Mr. Skimmer will take care of it.

Now, then, while this is proof in itself, that oil floats and that while floating may be skimmed off and carried away, yet we may go further, and point out the R. I. Ry. Co., which uses, in this section of the country, crude oil for a scale remover. More than this, I can show anybody my boilers, can refer them to the inspectors, and finally convince them by actual demonstration that, giving me an otherwise clean boiler, oil won't cause bags nor blisters. I use crude oil for removing scale when nothing else will do the work. And I have stopped my worrying over any dangers caused by oil in the boilers.

When one gets right down to facts, and admits the truth, we will find that dirty or neglected boilers

cause the bags. The last bag I had was somewhat of a mystery until I had opened the boiler, for I had cleaned it thoroughly only the day before. But at that time I was carrying on a series of experiments with potatoes as a scale preventer, and the fireman had had his little boys playing around the boiler room. It was late when I finished the boiler, and I told the fireman to get the potatoes ready and put them in the boiler. He, it being about his quitting time, did not put the potatoes in the cage, but, without even looking at them, threw them into the boiler.

Now, the little boys had been playing with them, and had mixed several rocks with them, not knowing what they were for, nor with any evil intent. So, they being fully as large as eggs, went in with the potatoes. There were five of them, and when I opened up the boiler, in order to cut out the bag, they were laying in the dropped sheet, as prettily as a nest of eggs. But they cost the company about $40, and the fireman his job.

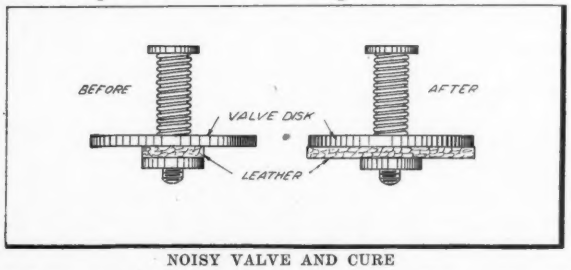
So now I do my own boiler washing from start to finish, and know when I'm done, just the shape things are in. And while there is considerable oil in my boilers at the present time, I am not in the least troubled, as I also know that it causes the scale forming matter to collect on the surface, where it is held in suspension, and so can be blown off with a surface blow off. I would be glad for any of the boys to tell me how they have ever proven, even to their own satisfaction, that this oil is on the lower part of the shell's surface, when the circulation is being kept up by the fires beneath, for I've proved, to my own satisfaction, that it is on the surface, and can all be removed by the use of a good skimmer. John Pierce.

TROUBLE WITH VACUUM PUMP

A VACCUM pump which was used for a vacuum cleaning system in a large public building had been giving a great deal of trouble due to noisy valves. The cylinder was 19 in. bore by 12 in. stroke and ran at a speed of 150 r.p.m., carrying from 16 to 18 in. vacuum at the machine.

The machine was overhauled by the engineer, but seemed to be worse than ever, and for some time it made so much noise when running that it was impossible to hear ordinary conversation when standing within 30 ft. of the machine.

At this time the writer decided to put a stop to the racket if possible. The discharge valves (10 in number) were taken out and examined. They were of the poppet type, held in a cage and seated by a spring. The seat was flat, 2⅝ in. outside diameter, the valves being made as shown in the sketch. From these sketches it is seen that the valve seat is covered by the leather washer to prevent the valve striking metal to metal. This washer had become cut away, as shown in the left hand figure, allowing the steel valve to strike directly on the seat, which it did.



NOISY VALVE AND CURE

The leather is held in place by a plate and 3 ¼-in. rivets and it took about 1 hr. to put the new leathers on which were cut from a piece of new 2½-in. singleply leather belting. This stopped the pound of the valves at once.

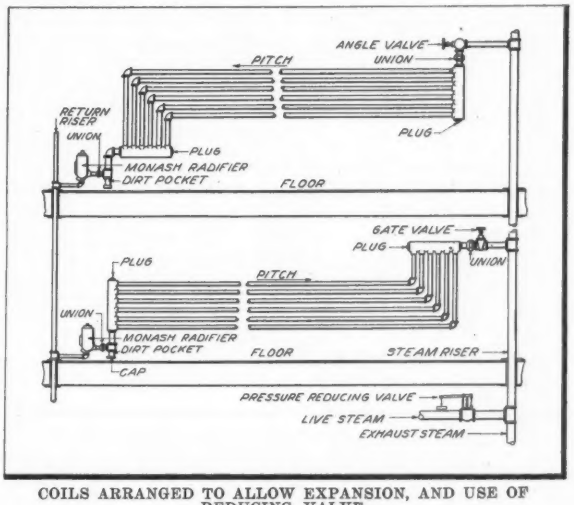
In his examination, the engineer, who was not familiar with this class of machinery, overlooked the leathers on these valves, as they were all neatly trimmed off flush with the bottom plate.

J. C. Hawkins.

HEATING SYSTEM SUGGESTIONS

REFERRING to your June 15 number, on page 640, under the head of Heating System, is an article and layout shown and signed by P. C. on page 641.

In Fig. 1, page 640, he shows a coil 20 ft. in length and 11 ft. in depth which, to start off with, is altogether too large a unit to run economically for heating purposes and absolutely no provision has been made for expansion of the pipes used. Regardless of the size of the unit of radiation, provision must always be made for expansion. To illustrate this, we enclose herewith sketch which shows the coil mitered on one end. They do not necessarily have to be mitered like the sketch which we enclose, but the expansion must be taken care of in some manner or there will be trouble, and besides these manifolds shown, 11 ft. in length would have to be made special for the job, as there are no such manifolds manufactured by any heating manufacturer.



COILS ARRANGED TO ALLOW EXPANSION, AND USE OF REDUCING VALVE

Then in Fig. 2, page 641, he shows these connected up without any valve on the supply to the coil from the main, which is, of course, wrong, as according to the layout the whole system would either have to be on or off.

In Fig. 3, page 641, he shows the method of introducing live steam into the 6-in. steam main when the engine is not running. This scheme is not good. The live steam should be introduced through a reducing valve and at about atmospheric pressure. This reducing valve, properly installed, is automatic and only lets in live steam when the supply of exhaust steam has given out.

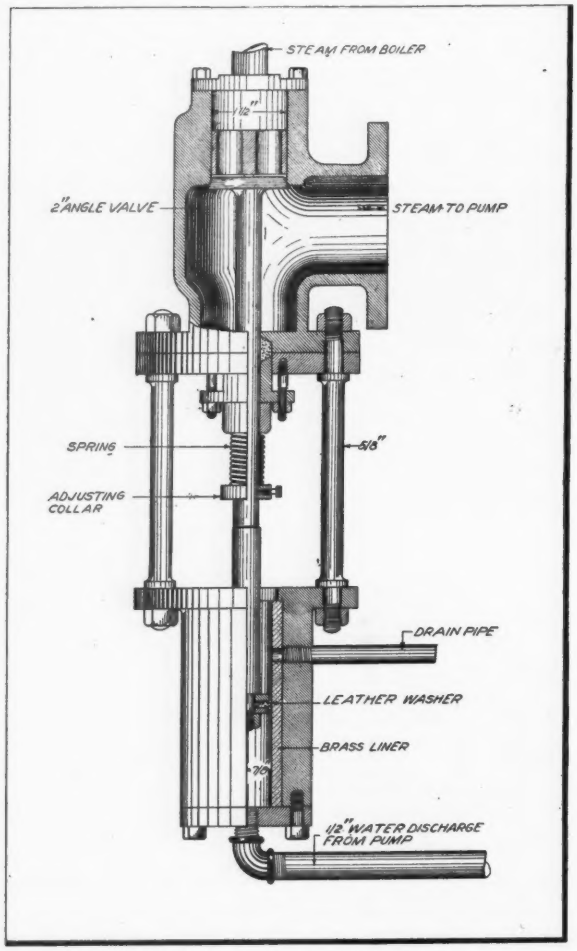
Another point overlooked is that no provision has been made for taking care of the air in the system.

J. H. Martin, Jr.

[As we understand, the object of the siphon is to cut down back pressure on the engine rather than to supply live steam.—Editor.]

AUTOMATIC PUMP REGULATOR

ON several of our service pumps the water pressure is kept constant by means of a regulator of our own make. The steam valve is an ordinary angle valve and is a little less in diameter than the chamber in which the water regulator moves. A spring is put on



HOME-MADE AUTOMATIC PUMP REGULATOR

steam valve spindle and the tension in this spring can be adjusted by a collar. The drawing will make the necessary explanation and readers can get a clearer idea of its working by studying sketch.

James A. Campbell.

HUNTING PUMP TROUBLE

IN hunting pump troubles in many cases a liberal use of a good pressure gage will often throw much light on what would otherwise be a mystery. We, in a pump trouble that does not yield to ordinary remedies, usually apply a gage to the discharge pipe of the pump. Often we find that we have a choke-up on the line and that the pump is working against a higher pressure than it should. A vacuum gage on the suction line will also sometimes show up the source of the trouble.

Only last week applying a gage along a water supply line saved us the trouble of tearing down a pipe line by showing us that the line was not choked but too small, which we remedied by supplying a part of the demand from another line nearby at little cost.

Once when I had a shift on an absorption ice machine we were in great trouble for several days right during the hot season when the market for ice was at its best by the refusal of the machine to do more than a small per cent of its rated capacity.

We had all been on the job night and day doing everything we could think of to locate the trouble without success. While sitting alone in the pump room trying to study out the problem it occurred to me to apply a gage to the weak liquor line from the retort to the absorber. Starting at the retort the pressure showed normal up to an elbow under the exchanger, where it fell off to 15 or 20 lb. If we had been onto our job we would have made this test at the beginning and saved the company considerable loss and ourselves much morry and useless work.

Occasionally we read an inquiry as to how an injection will behave in taking its water under pressure instead of having to lift from a well or source of supply below. As we have used them for years as spare boiler feeders taking the water under 20 to 40 lb. pressure, we feel qualified to assure them that the average injector will be as satisfactory used this way as the way lifting.

The valve on the supply line should have the disk secured to the stem with the least possible lost motion.

J. O. Benefiel.

AN EMERGENCY

STUDENT, in the June 1 issue, in speaking of his piston rod screwing out of the cross head asks what he should do in the emergency.

First, he should close the throttle as quickly as possible, never mind the circuit breaker or load, this will help to stop the engine so much quicker. If the machine is running in parallel the breaker should be tripped as soon as the throttle is closed. After the engine is stopped, get a pipe wrench on the rod close up to the nut and screw it back. Some engineers have a mark on the rod at a known distance from the crosshead which makes readjusting easy, but if this is not the case, screw the rod in to about where you think it ought to be and try the engine, if it does not hit either head tighten up the check nut and you can run until some convenient time to equalize properly the clearance. On an engine of this size the delay ought not to be over 10 minutes, unless some damage is done by the piston striking the head.

To equalize the clearance, disconnect the crosshead, or take out the crank brasses which will give play enough to push the crosshead back until the mark on the crosshead corresponds to the striking point mark on the guide and screw the rod in or out till the piston just touches the head, then push the crosshead up until the piston strikes the other head and measure the distance the mark on the crosshead has passed that on the guide then screw the rod in one half of the difference and tighten the check nut. Put in the brasses and start up.

If that check nut persists in working loose, drill and tap a ½-in. hole in one side and after the nut is up tight, turn the set screw up tight against the rod, this will prevent the nut from turning.

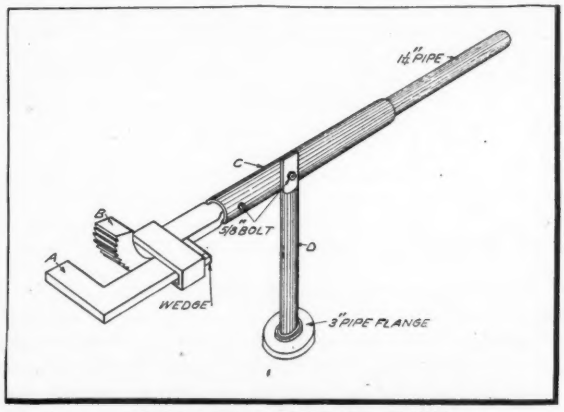
J. C. Hawkins.

Successful Kinks From The Plant

For Saving Time, Work and Trouble

Engine Jack

FOR turning the engine over the jack shown in the illustration has done excellent service in our plant. Piece marked A is made of steel 8 in. long or to suit the rim of the wheel, it is ⅞ in. thick and 2 in. wide and is held in place by a wedge. Piece B is held in the handle C with a ⅝-in. bolt, it is 9 in. long, ⅞ in. thick and 2 in. wide. A band of tool steel is riveted



ENGINE JACK MADE IN PLANT

to B and must work up and down as the handle is worked. The band is made with an opening 2 by 2 in. of ½-in. steel 2 in. wide and fits snugly around A and B, and A is kept from slipping by a wedge.

The support D is made of 1¼-in. pipe the end of which is heated and pounded flat for a bolt.

I have a 250-hp. engine with flywheel 14 ft. diameter by 32-in. face, and 100 ft. of 4-in. line shafting with 4 big pulleys and loose belts to turn. The jack described gives the best results of any I have tried.

T. Ruffener.

Freezing Steam Pipe to Make Repair

WE take special pride in being able to say that our plant has not had an interruption in service for several years. We must not and do not let the current cease even for a minute from one end of the year to the other. In case of repair or new work or changes that have to be made it sometimes calls for special scheming in order to do such without shutting down. In operating under such conditions I have had to make use of a good many stunts or kinks and here is one I recently made good use of which may be of interest to some one else in a similar fix.

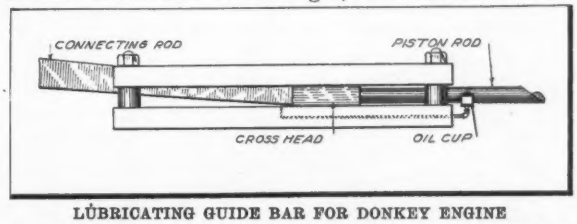
In order to make room for some new work a 1-in. pipe used as a drain on a separator in the 10-in. high-pressure steam line had to be disconnected between its value and the separator. There was no way of shutting steam off the 1-in. pipe except by shutting off the 10-in. line which supplies all the generating units in the plant.

It looked as if we were up against the impossible this time. But I decided to try an experiment, choosing the time of day that would be the least serious in case of a failure. There was a valve near the end of the drain pipe. I closed it in order to let the pipe fill with water. I then took a piece of 5-in. pipe covering 3 ft. long and put it around the 1-in. pipe just above the place where I wished to disconnect it. I closed the lower end of the pipe covering with a piece of board by boring a hole in it and split it through the hole. I then filled the pipe covering with a mixture of 1 part salt and 2 parts crushed ice, and ordered my helper to keep it packed full for at least 3 hr. I placed a thermometer in the freezing mixture and it dropped from a 100 above temperature of engine room to 5 below in only a few minutes and was going still lower when removed so I had no doubts about its ability to freeze. I gave it 4 hr. for good luck, however, and then opened the valve and found the pipe frozen solid. We cut the pipe in two with a hack saw a few inches below the frozen section, unscrewed a short piece and put on a valve keeping the freezing process going on while making the change. We then removed our freezing arrangement and left the pipe to thaw out and the job was done. The steam pressure in the pipe was 125 lb., which was held by the ice-plug having of course enough water on top to keep the heat away from the ice. Freezing a pipe is not a new thing in plumbing but have not heard of it applied in steam work to avoid interruption in service.

Jno. O. Olson.

Making Lubricating Guide Bar for Logging Donkey

TO make lubricating guide bars on a logging donkey, drill a hole in the end of the guide bar lengthwise to or near the middle of its length, then another down if



LUBRICATING GUIDE BAR FOR DONKEY ENGINE

the engine is running under, as all compound donkeys do, or up if it runs over, then tap the hole out to take a ¼-in. nipple, put on an ell and a sight feed drop cup.

Wm. Carpenter.

TO PRESERVE STEEL FROM RUST use 1 part caoutchouc, 16 turpentine. Dissolve with a gentle heat, then add 8 parts boiled oil. Mix by bringing them to the heat of boiling water; apply to the steel with a brush, in the way of varnish. It may be removed with turpentine.

TO CLEAN BRASS mix 1 part Roche alum and 16 water. The articles to be cleaned must be made warm, then rubbed with the above mixture, and finished with fine tripoli.

ABSORBING HEAT

Most Economical Method of Taking Heat From Gases of Combustion by Boiler and Economizer Surfaces

COST of generating steam consists of 2 main elements, one the expense for fuel and labor, the other interest, depreciation and other fixed charges upon the boiler, boiler setting, grate, draft apparatus and fittings. If the amount of boiler surface employed to develop a boiler horsepower, that is, to evaporate 30 lb. of steam per hour, be increased, the amount of heat recovered from each pound of fuel will, within the limits of ordinary operation, also increase. That is, more heat will be absorbed, and the gases will be discharged to the stack and to atmosphere at a lower temperature as shown graphically in Fig. 1, Data Sheet.

At the same time, however, that the cost of steam is being reduced by increasing the efficiency of heat absorption, the element of cost due to the fixed charges on the boiler and its appurtenances is rising. The rate at which heat is absorbed by any element of the boiler surface depends directly upon the difference between the temperature of the contents of the boiler, and the temperature of the gases of combustion in contact with that part of the boiler.

If the amount of heat absorbed by that particular part of the boiler is worth more than the fixed charges corresponding, such element of heating surface is paying for itself; but as the temperature of the gases falls and approaches the temperature of the steam and water within the boiler, a point must soon be reached where the heat absorbed will no longer pay the fixed charges upon additional boiler surface.

Limit of Boiler Heating Surface

JUST where this limit comes will, of course, depend upon the price of fuel, the charges upon boiler surface and the proportion of the whole time that the boiler surface is being used. Referring to Fig. 2, Data Sheet, it will be seen that for plants operating 10 hours a day, 300 days a year, and using $3 coal, the limit is reached when the gases are reduced to a temperature 285 deg. F., above the temperature of the steam.

If we assume steam at 150 lb. gage pressure, which corresponds to a temperature of 366 deg. F., it will be seen that the lowest temperature to which it will pay to reduce the flue gases under the above conditions is 650 deg. F., showing by reference to Fig. 1 that it will not pay to put in more than 4 or 5 sq. ft. of boiler heating surface per boiler horsepower developed.

However, as is at once apparent, considerable heat would be wasted under these conditions. If we assume a coal containing 14,000 B.t.u. per pound, burned with 26 lb. of air per pound of coal, and the boiler room temperature at 70 deg. F. the temperature in the fire will be about 2,230 deg. F., and if the same gases of combustion are discharged at 650 deg. approvimately 27 per cent of the total heat of the fuel will be lost in the chimney gases.

Fortunately, there is a use for this heat, viz.: in warming up the cold water which is to be fed to the boiler. This water may have an initial temperature of anywhere from 50 or 60 deg. F., in case the water is taken from a well or stream, up to 200 or 210 deg. F., in the case of returns from heating and drying coils or water heated in an exhaust steam feed-water heater. Taking water at 200 deg. F., for instance, it will be seen that between such water and flue gases at a temperature of 650 deg. F. there is a difference of 450 deg. F., under which conditions the provision of additional heating surface would again become profitable.

The remedy, obviously, is to divide the process of steam generation into 2 parts, one of which consists of heating the water up to the boiling point, and the other the evaporation of boiling of the water; that is, to apply the counter-current principle, which has proved most economical in heat transferring apparatus of all kinds.

Feed water may be heated in an economizer, and the boiler and economizer, connected as shown in Fig. 3, become in effect a counter-current apparatus for the transfer of heat from hot gases of combustion to water which is to be turned into steam. The economizer costs somewhat less than the boiler per square foot of heating surface, and the temperature differenece at which it ceases to be profitable is therefore lower, as will be noted from Fig. 4, Data Sheet.

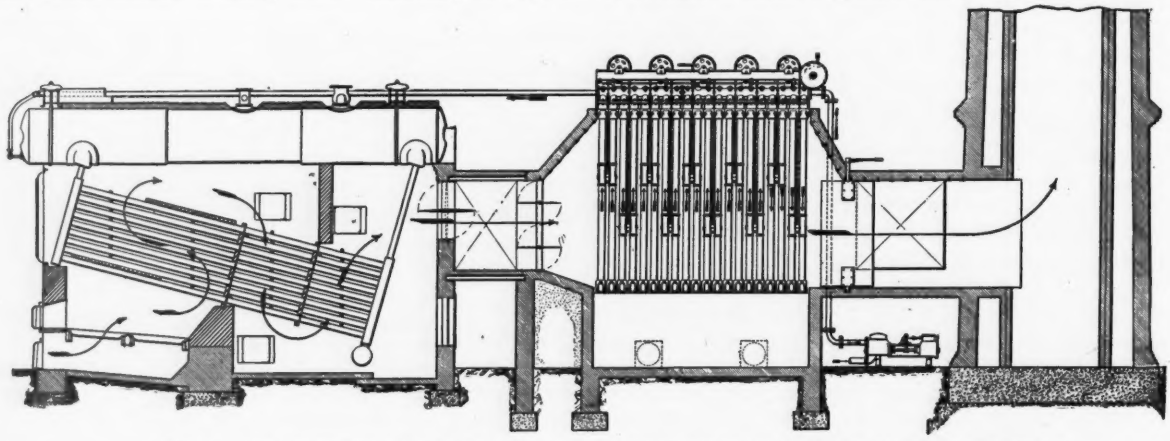


FIG. 3. ARRANGEMENT OF BOILER AND GREEN'S ECONOMIZER ON COUNTER CURRENT PRINCIPLE

As an example, suppose that fuel costs $3 a ton and the plant is operated 300 days a year and 10 hours a day. It will be seen that the lowest economical tem-

perature difference is 130 deg. F. If the initial temperature of the water entering the economizer is 200 deg., as previously assumed, this will give as a final temperature of the flue gases 330 deg. F., which is still hot enough to produce sufficient draft with a good chimney.

In the design of large steam power plants this principle has been recognized and is being applied; that is, the boiler surface is being considerably curtailed, while the efficiency of heat absorption is maintained or even improved by substituting the cheaper and more effective economizer surface.

Another thing, increased boiler pressures, toward which practice is tending, raises the limit of temperature to which flue gases may be economically reduced by absorption of heat by the boiler. This reduces the heat head and leaves a larger duty to be performed by the economizer.

With better economy of auxiliaries, such as pumps and fan engines, less exhaust is available to heat the feed water in exhaust heaters, so that it is not uncommon to find plants in which there is difficulty in maintaining a temperature at 160 deg. F. in the water leaving the heater. Naturally the colder the water entering the economizer, the greater will be the activity of its surface in transmitting heat from the gases.

Fuel saving to be expected from the installation of economizers may be estimated roughly at the rate of 1 per cent each 10 deg. F. through which the water is raised in temperature; or, in the average plant, 1 per cent for each 20 deg. F., by which the temperature of the flue gases is reduced. Inasmuch, however, as the determination of the number of degrees that the water will be heated or the gases reduced in temperature by an economizer of given size involves considerable calculation and some knowledge of economizer engineering, it is more convenient to use the chart presented in Data Sheet, Fig. 5, which is based upon the actual results secured in some 200 plants where economizers have been installed.

Suppose, for instance, that $3 coal is being used, as before, and that it is decided that the economizer should show a gross saving of 30 cents per sq. ft. per year. If the plant is operated 10 hours a day, 300 days a year, or 3000 hr. a year in all, it will be in operation only a little over one-third of the time for which the chart has been made out, namely, 24 hours a day, 365 days a year, or 8760 hr. Therefore to earn 30 cents a sq. ft. for the year as a whole, a square foot of surface must earn at a rate approximately 3 times as great, or 90 cents, on the basis of the time for which the chart is figured.

Finding 90 cents in the $3 coal column, run horizontally until the curve is encountered, from which it is seen that 1.1 sq. ft. of surface should be installed per boiler horsepower developed, for each 100 deg. F. difference between the temperature of the flue gases and the temperature of the water entering the economizer. Supposing as before that the former is 650 and the latter 200 deg. F. giving a difference of 450 deg. F., it will be seen that 5 sq. ft. of enconomizer surface should be installed for each boiler horsepower developed; that is, each 30 lb. of water turned into steam per hour.

THE AIR PRESSURE produced by an explosion often renders a miner unconscious, so that the after-damp catches and kills even when the victim was neither burned nor near the initial explosion.—Compressed Air Magazine.

HARNESSING TALLULAH FALLS

Large Hydro-Electric Project in Course of Construction by Georgia Power Co.

HARNESSING Tallulah Falls by the Georgia Power Company, Atlanta, Ga., will develop ultimately in the neighborhood of 100,000 hp. The falls, located about 90 miles northeast of Atlanta in a mountainous region of Georgia, is one of the most picturesque cataracts in the country and has long been termed the "Niagara of the South." This hydro-electric development, one of the largest in the South, will serve a territory with 225,000 population, distributing energy for manufacturing, lighting and traffic in Gainesville, Atlanta, Newman, LaGrange, Marietta, Cartersville, Cedartown, Lindale, Rome and intervening towns.

The work under construction embraces principally 2 dams, the tunnel, the forebay, the power house and the switch house, together with 5 main substations. The main power dam is of the cyclopean type of masonry and is being built of rock from a quarry just below the site of the dam. It will measure 384 ft. long by 112 ft. high. The upper dam, about 8 miles upstream and designed for storage purposes, is to be 650 ft. long by 90 ft. high and will impound nearly 4 billion cu. ft. of water.

About 50 yd. from the power dam starts the intake end of the tunnel, which is being lined with concrete averaging 12 in. thick, will be 12 ft. wide at the widest point, 14 ft. high to the top of the arch, will extend 6600 ft. long and convey the water to the forebay. The forebay is being constructed 30 by 70 by 93 ft. deep and also lined with concrete. Six steel penstocks carry the water down the side of the gorge, a drop of 600 ft. in 1000 ft., to the power house. This structure will measure 48 by 192 ft. and will be built of brick, steel and concrete. The switch house is to be constructed of the same kind of materials and will have foundations 50 by 250 ft.

The flow through each of the 6 penstocks will drive a single S. Morgan-Smith Company 16,000-hp. vertical turbine, each turbine being direct connected to a 10,000 kv.-a., 3-phase, 60-cycle waterwheel type generator. Direct current excitation for the alternating generator units will be furnished by an equal number of 100-kw. 250 volt exciter sets. Current will be generated at 6600 volts and the voltage will be stepped up to 110,000 volts by eighteen 3333 kv.-a. transformers for transmitting the current over high tension lines to the distant towns and cities. All this electrical apparatus, including switchboards, lightning arresters and also the substation equipments is being supplied by the General Electric Company.

The location and present equipment of the main substations will be: Lindale, 6 1000 kv.-a. 110,000 volt transformers and switchboard; Newman, 3 1000 kv.-a. 110,000 volt transformers and switchboard; Cartersville, 3 1000 kv.-a. 110,000 volt transformers and switchboard; Atlanta, 9 3333 kv.-a. 110,000 volt transformers and switchboard; Gainesville, 3 500 kv.-a. 110,000 volt transformers and switchboard. All of the substation transformers are of the outdoor type. The transmission lines are in duplicate and are carried on steel towers throughout. The main circuit is of 4/0 copper and the branch circuits of 2/0 copper, all carried on suspension insulators.

It is anticipated that the construction work will be completed and the apparatus installed and in operation some time during the coming fall.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Crosshead Travel

WHY does a crosshead travel farther from A to B in the accompanying sketch than from B to C.
R. O. L.

Reference to the accompanying sketch should make it clear why the crosshead travels farther from A to B than from B to C. Assume that the crank has traveled from head end, dead center C, to B. It will be seen by the dotted line 1-B that the crank pin has traveled in a vertical distance equal to the length of that line but in a horizontal distance equal only to 1-C.

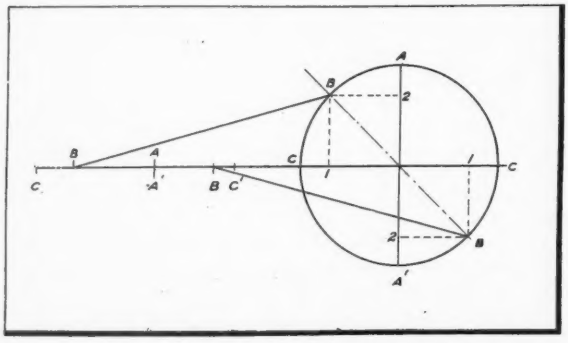


DIAGRAM SHOWING CROSSHEAD TRAVEL

When the crank pin moves from B to A it travels horizontally a distance equal to the dotted line B-2 and vertically equal to the dotted line A-2. During this 90 deg. movement the crosshead travels successively from C to B to A.

The same cycle of operation take place on the return stroke from C'. N. G. M.

Water Pressure in Tank

WILL you kindly work out the following problem for me, giving the formula you use?

A concrete tank is to be built for a large power station to serve as a reservoir of water in case of emergency. The tank or reservoir is to be 50 ft. long, 40 ft. wide and 10 ft. high. I wish to know what pressure is exerted on the walls by the water and what size and shape walls will safely carry the water.

Please give method of finding the water pressure against the walls for different heights. F. M. P.

A. For a concrete tank 40 by 50 and 10 ft. deep, the total pressure on the side wall would be found by multiplying the length by the height of the water and by the distance of the center of gravity of the wall below the water surface, and by the constant 62.5. In the case given, the center of gravity will be at half the height of the water. For the long side of your reservoir the pressure would then be 50 by 10 by 5 by 62.5, or 156,250 lb., which would be 3125 lb. per ft. of length. The center of pressure would be at ⅔ the total depth of the water or ⅓ up from the bottom, and the pressure per sq. ft. on the bottom of the tank will be found by multiplying the depth of the water by 62.5, or in your case it would be 625 lb. per sq. ft.

Ignition From an Exciter

IN the May 1 issue of Practical Engineer there was a question and answer regarding ignition from a lighting circuit. We have a 3 cylinder oil engine and spark it from current from our exciter. The engine drives a 50 k.v.a. 2300-volt alternator and this arrangement, as shown in the sketch, gives us better service than a magneto and I think if C. D. would try this plan, using

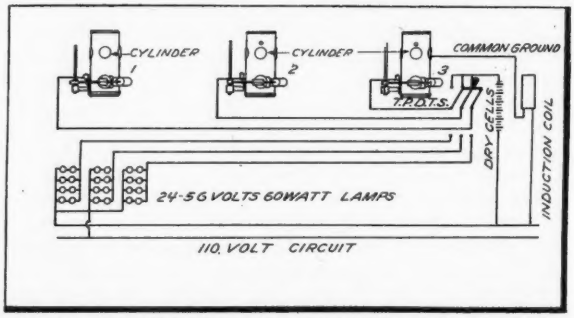


DIAGRAM OF CONNECTIONS FOR IGNITION FROM AN EXCITER

110-volt lamps across his 220-volt circuit it would give him satisfaction. The 110-volt lamps will, however, burn the points off a little faster. We first ran the lamps in parallel, but did not get enough amperage, so we put on more lamps, cut down the voltage and got more current, which gives better results. Should like to read more letters from men who are running oil engines. G. A.

Cards for Criticism

I SHOULD like to have the accompanying indicator cards criticized. They were taken from the high-pressure cylinder of a 26 by 48 in. stroke engine, rod diameter 5¾ in., boiler pressure 180 lb., indicator spring 50. Indicator pipe on the crank end is split. Kindly let me know the horsepower developed. O. L.

A. The indicator diagrams show good work in valve setting; the points of cut-off, release, exhaust closure, and admission being each and all correctly located. There is, however, considerable drop in pressure between boilers and engines, as the boiler pressure is 130 lb. while initial pressure as shown by the diagrams is 113 lb., a drop of 17 lb. due to some unexplained cause.

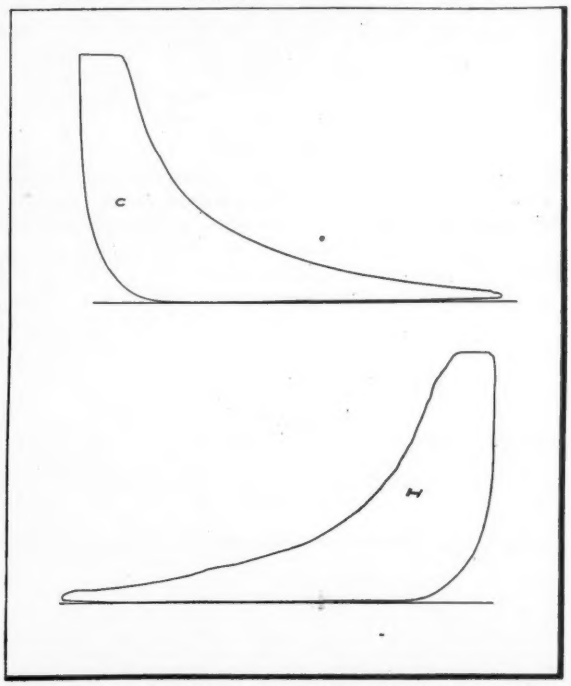
Cutoff occurs at 10 per cent of the stroke in both ends of the cylinder, but there is a difference of 2.3 lb. between the m.e.p. for the 2 ends; that in the crank end being 33.4 lb., while in the head end the m.e.p. is 35.7 lb., as shown by the diagrams. The principle dimensions of the engine are as follows: diameter of cylinder 26 inches, stroke 48 inches, diameter of piston rod 5¾ inches. The number

of revolutions per minute is 89, and the scale of the indicator spring is 50.

Cross sectional area of the piston rod is 25.95 sq. in., and should be deducted from the piston area in figuring the total pressure exerted in the crank end; and if the rod extends through the back end also, as is the case with many large engines, its sectional area must be deducted from both sides of the piston if accurate results are desired.

If we assume in the case under discussion that on the engine from which these diagrams were taken, the piston rod does not extend through the back head; the variation in m.e.p. will cause the engine to develop 38 more hp. in the head end than it does in the crank end, as may easily be calculated from the following figures:

Head end working area of piston = 530.93 sq. in., m.e.p. 35.7 lb., i.h.p. 204.4. Crank end, working area of



CARDS FROM A 26 IN. BY 48 IN. STROKE ENGINE FOR CRITICISM

piston = 530.93 sq. in. less area of rod (25.95 sq. in.) = 504.98 sq. in., m.e.p. = 33.4 lb., i.h.p., = 370. Difference in amount of work performed in the 2 ends 204.4 — 148.7 = 19.7 hp.

This seemingly large variation in m.e.p. as shown by the diagrams may, however, be accounted for in another way. The correspondent who furnished the cards says that the indicator pipe leading to the crank end is split, which may account for the expansion curve on the diagram from that end approaching nearer to the atmospheric line than does the curve on the head end diagram. The slightest leak in any portion of the indicator piping will cause the instrument to give a false reading, especially after cutoff occurs.

C. F. Swingle.

Electrical Questions

HOW may I read a polyphase watthour meter by the revolutions of the disk? A d.c., kw.-hr. meter? A d.c. meter with a constant?

2. Is there a short rule of calculating the size wires for a circuit knowing the number of lamps, amperage or hp. of a motor?

3. At what rate does an electric current travel per second?

4. What in your opinion causes the commutator on a shunt-wound motor (220 volts) to blacken, coating the surface of the brush contact of the commutator with a black paste?

Sandpapering both the commutator and brushes, shifting the brushes, the use of vaseline, all are of no effect. The machine rarely ever runs over three-fourths of its rated load. After a few hours' running the commutator gets quite warm and the armature quite hot; at times the brushes sparke some.

5. What causes the copper of the commutator to disintegrate or break away immediately back of the mica insulation? Can you recommend a good home-made commutator compound?

A. The general formula for testing integrating or recording meters with a revolving disk is:

$$P = \frac{nr \times K \times 3600}{T}$$ in watts. P = power in watts, nr = total number of revolutions, K = constant, T = time in seconds.

By turning on several lamps of known candle-power and voltage, counting the revolutions of the disk in any given number of seconds, the meters can be fairly accurately checked, although for true accuracy, meters should be compared with a standard testing meter.

2. A standard formula for figuring the size of wire for direct current motors of any size is:

$$A = \frac{(P \times 746 \times L \times 22 \times 1.25}{E \times e \times \text{efficiency}}$$, in circular mils. P = rating in horsepower of motor, L = the distance in feet to motor, E = impressed e.m.f., e = drop in voltage.

$$A = \frac{22 \times N \times i \times L}{e}$$, in circular mils. N = number of lamps, i = current per lamp, L = length of circuit, e = drop in voltage.

3. We have no definite information at hand as to the rate at which electric current travels per second. We believe, however, that some experimental work has been done in this direction but have not heard the results of the tests as yet.

4 and 5. From the explanation of your motor troubles we should say that they are due to hard mica in the commutator. Under such conditions the copper wears faster than the mica, allowing the latter to protrude beyond the periphery of the commutator, causing chattering and sparking, also burning. The disintegration of copper in the commutator bars adjoining the mica is generally caused by sparking, and sparking may be due to a great many causes. We would suggest that you test your motor for short circuited or open coils or broken connections.

6. A good commutator compound can be made by adding to melted paraffin as much powdered graphite as it will dissolve and then running the mixture into molds and allowing it to harden. N. G. M.

AS A COVERING for the floors of hospitals, schools, office buildings, etc., a new material called Adamat flooring having a felt mat face with a gummed surface on both sides is now being manufactured. The surfaces are not corrugated and yet are non-slipping. This material can be had up to 90 ft. in length, making an ideal runner for halls. The material is made by the Flintkote Mfg. Co., of New York City.

Problems For Discussion By Readers

What Would You Do If You Had These Conditions To Meet?

Belt Troubles

WE frequently have trouble with our 20-in. double leather belt which drives the countershaft of an air compressor. The sketch represents the belt together with arrangement of pulleys, etc. The belt occasionally tries to get off of the pulley, but at other times rides alright. Can some of the readers tell me what is wrong? The engine runs at 74 r.p.m., the driving pulley is 8 ft. in diameter, face 20 in., driven pulley 4 ft. 10 in., as per sketch. The air compressor is a duplex double-acting 18 by 18 in. and is driven at 70 r.p.m. The receiver pressure is maintained at 20 lb. gage. The engine runs under.

When we apply dressing to this belt it always has to be done after the load is taken off, otherwise it is sure to give us more trouble than it does ordinarily. Belt is not too loose. The lacing in this belt has frequently to be renewed, this job always falls on the machine shop

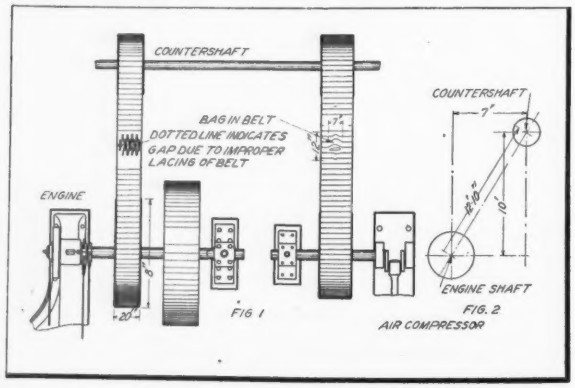


FIG. 1. ARRANGEMENT OF BELTS AND PULLEYS
FIG. 2. END VIEW OF ARRANGEMENT

men, and since I have been at the plant I always noticed that 2 men do the lacing; they start the laces at the center holes and each man works toward his side of the belt. This, I told the chief, was all wrong and bad, or, if continued, would ruin the belt, because the lacing on one side of the center line of belt is likely to be drawn tighter than that on opposite side, and the tight side would tend to run up higher on the pulley face than its proper position requires, also, after a few such lacings, all the stretch will be taken out of one side, while the other side will not have been stretched at all. Even a moderate condition of this kind is hard to remedy, because tension must increase as the elastic limit is approached, and we cannot know (except by the action of the belt in service) when the amount of stretch of one side of the belt is balanced by the amount of stretch on the opposite side; and besides, a tension that would balance the elastic pull of both sides of the belt could not be had nor applied in service until both sides of the belt had been stretched an equal amount, because once a belt or a part of a belt has been stretched a certain amount it can be stretched the same amount a second time with less tension than was required the first time. I believe the lacing will stay where it is put, and will not, to any appreciable extent, crawl through the lacing holes to distribute tensional stresses. What do readers think about it?

Belt from countershaft to air compressor has a bad bag in it also; it is indicated by sketch; will some of Practical Engineer readers tell me how it got there and how best to remove it? Fig. 2, being an end view, shows the right angled triangle arrangement of pulleys together with distances. Thos. C. Robinson.

Engine Card

ENGINE card shown in the accompanying illustration was taken when the generator was carrying 200 amp. at 550 volts. The engine is a single cylinder

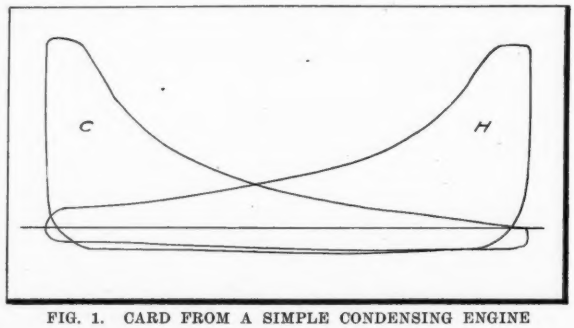


FIG. 1. CARD FROM A SIMPLE CONDENSING ENGINE

type, 95 r.p.m., 36-in. stroke. Diameter of cylinder, 18 in.; diameter of rod, 2⅞ in. At the time of taking the card there was a 24-in. vacuum and the boiler pressure was 95 lb. Scale used was 50. Should like the comments of the readers on this card. J. S.

Voltage Drop in Generator

IN answer to C. M. in the May 15th issue of Practical Engineer, I think the cause of his generator dropping the voltage is a common one, but not noticed where there is a resistance in the shunt circuit. When the machine is first started up the fields are cool and of the proper strength to give a normal voltage, but as they warm up the resistance of the wire increases which lowers the current flowing through them and, therefore, lowers their strength, and consequently the voltage. In the usual case this is remedied by cutting out a little of the resistance in the rheostat to maintain the proper field strength, but as he has no resistance in the field circuit the drop is more noticeable.

His field coils may run quite cool, and still heat up enough to make a great difference in the voltage. There are several ways to remedy this trouble, but in his case I think he wants the simplest and, yet the most reliable method that he can get, and I would advise him to get a rheostat and place in the shunt circuit, then speed up his engine until he gets the normal voltage after the machine has been running some time, then when he first

starts up he can cut in resistance to keep the voltage from going too high, gradually cutting it out as the machine warms up. If he can change the speed of his engine while running this is all that is necessary as he can regualte the speed to suit the voltage, increasing the speed as the voltage drops.

This can be done on some small gas engines but possibly not on his. If not, he will require a constant higher speed, and shunt resistance to maintain the proper voltage. He can make a resistance of iron wire or use a barrel of water, but I would suggest as a better way that he take the matter up with an electrical manufacturing company, stating size, capacity and any other information that may be needed, and let them determine just what is needed. This will be a sure cure, the most reliable and the least expensive in the end.

In one case of a 10-kw. outfit without shunt resistance I used a 10-hp. starting box by taking off the spring on the handle and, connecting the field leads to the contacts marked "arm" and "line" this worked very well.

J. C. Hawkins.

Voltage Drop in Generator

REGARDING "C. M.'s" generator trouble which he outlines on page 541 of May 15 issue of Practical Engineer, I will state that this condition is not peculiar to his particular machine; on the other hand, it is characteristic of all shunt and compound wound machines.

I take it from reading his article that his machine runs only during the day, or night; as the case may be; as he states that the voltage is 110 for an hour or so after starting up, when it drops to 90, the speed remaining the same.

I reason the conditions are something like this: When he starts the machine up, after it has stood idle for some hours, the shunt field coils are at about the temperature of the surrounding air, and their resistance at the lowest point, while in this condition they allow enough current to pass through the shunt field coils (with no rheostat or other resistance in series) to magnetize the poles to such an extent, that with the armature revolving at its normal rate of speed the armature wires cut through enough lines of force to generate current at 110 volts. Now as it is impossible to pass a current of electricity through any conductor without a rise of temperature; and as the resistance of nearly all conductors increase with the temperature (carbon being an exception) it follows that from the time he starts up his machine, until it has assumed its normal working temperature, the resistance of the shunt field coils increase, thus permitting a smaller amount of current to pass through them, causing the fields to become weaker and the voltage to drop, which in turn has a tendency to aid in bringing about the conditions of which he complains. If current for the shunt fields was secured from another machine or source at a constant potential of 110 volts his voltage would not drop so far.

This state of affairs is kept up as long as the machine continues to warm up, which takes about an hour or thereabout, after which the shunt coils have assumed their normal working temperature, and their resistance, while greater than at first starting up, remains constant for this temperature.

Now as to the remedy, he should insert a rheostat in series with the shunt winding, and increase the speed of the armature to such an extent that the machine will generate current at 110 volts when first started up and all parts cool, and with some resistance in shunt circuit by means of the rheostat. Then as the machine warms up, gradually cut out this resistance, keeping his voltage at, or near, 110 and continue this until machine is thoroughly warmed up, when his voltage should remain nearly constant.

John Craig Scott.

How Many Gages?

IN the Practical Engineer issued June 15 J. R. asks how many gages of water to carry in a return tubular boiler. My opinion is that when the feed water supply is reliable, one in. in the glass is a good amount to carry, but when the water supply is liable to be stopped for some reason, I think about 3 in. is proper, as the fault may then be remedied before the water falls low enough to cause a shut down.

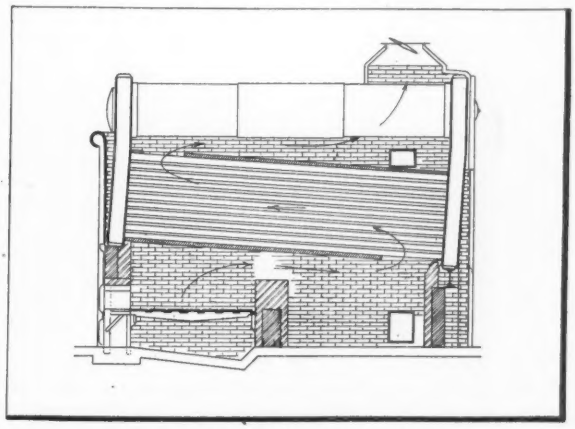
This brings to my mind the case of a fireman who was put to work. He persisted in carrying his glass full, making the statement that he had fired long enough to know that the more water he boiled the more steam he would make, and at the last place he fired they always had their boilers chock full, and sometimes they would run over.

Another fireman said that he understood that when there was 3 in. of water in the glass, it meant there was 3 in. in the boiler, but he couldn't understand why this was so. Needness to say, neither of these men are firing now.

R. M. Packingham.

Difficulty With a Boiler

ON page 640 of the June 15 issue of Practical Engineer F. J. asks the opinion of engineers concerning difficulty with a boiler. I would suggest changing the flow of the gases by tearing the bridge wall down to about 10 in. above the grates and remove the baffle plates.



SUGGESTED CHANGES IN BOILER

I would then put baffle brick on the bottom row of tubes extending from the front of the boiler to within 3 ft. from the rear, as shown in the figure, and on the top row of tubes place a baffle plate extending from the water leg to within 3 ft. of the front of boiler.

A Good Commutator Lubricant

I HAVE tried a great many methods of lubricating commutators, and I find that the best way to keep a clean commutator and to keep the brushes from chattering and also to avoid sparking is to boil the brushes in cylinder oil once a month. We have 2 rotary converters running at 900 r.p.m. and I keep an extra set of brushes in cylinder oil all the time and when we get ready to change, I boil them for about 24 hr., not enough to burn the oil. We never have any trouble with out commutators.

J. B. Linkes.

PRACTICAL
ENGINEER

PUBLISHED ON THE FIRST AND FIFTEENTH OF EACH MONTH
At 537 So. Dearborn Street, Chicago, Ill., by the
TECHNICAL PUBLISHING CO.

New York, 150 Nassau St. Cleveland, Am. Trust Bldg.

Subscription Price One Dollar a year in advance to any Post Office in the United States or Mexico or United States possessions.

To Canada One Dollar and Seventy-five Cents; to Other Countries Two Dollars and Fifty Cents a year. Single copies 10 cents.

Address all letters and make all checks and money orders payable to Technical Publishing Co., 537 S. Dearborn St., Chicago, Ill. Notify us at once of any change of address, giving the old and the new address, so that your paper may always reach you promptly.

Any advertiser is invited to examine our paid subscription lists and Post Office mailing receipts at any time.

Copyrighted 1912 by Technical Publishing Co.

Entered as second class matter May 1, 1908, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

Circulation of this issue, 23,500

CONTENTS

Test for Lubricating Oils. Frederick E. Dobbs. Illustrated..707
Condensing Water Cooling Reservoirs. Illustrated.....710
The Value of Exhaust Steam in Isolated Plants.....711
Bituminous Coal Gas Producers. C. M. Garland. Illustrated.712
Steam Turbine for Non-Condensing and Back Pressure Service. Illustrated 717
Transformer Connections. Illustrated.....718
Experiences on the Road. By Leonard Work.....720
Practical Electrical Engineering.....721
Synchronous Booster Rotary Converters. Illustrated.....722
Bill and His Grouch. By Walter H. Dunn. Illustrated.....723
Letters Direct from the Plant: Burning Oil. Air Chamber for Wall Coil. Lubricating with Water. Adjusting and Securing Loose Piston Rod. Washing Overalls. Oil in Boilers. Does Oil Cause a Bagged Boiler? Trouble with Vacuum Pump. Heating System Suggestions. Automatic Pump Regulator. Hunting Pump Trouble. An Emergency. Illustrated 724
Successful Kinks from the Plant: Engine Jack. Freezing Steam Pipe to Make Repair. Making Lubricating Guide Bar for Logging Donkey. Illustrated.....729
Absorbing Heat. Illustrated.....730
Harnessing Tellulah Falls.....731
Questions Answered and For Answer: Crosshead Travel. Water Pressure in Tank. Ignition from an Exciter. Cards for Criticism. Electrical Questions. Illustrated...732
Problems for Discussion by Readers: Belt Troubles. Engine Card. Voltage Drop in Generator. How Many Gages? Difficulty with a Boiler. A Good Commutator Lubricant. Illustrated 734
Editorial: Boiler Capacity vs. Economizer.....736
In the Buckeye State. Illustrated.....737
Empire State Convention 741
In the Blue Grass. Illustrated.....744
Gas Engine Exhibits and Convention. Illustrated.....746
Your Work and Mine.....751
A New Method of Measuring Steam Consumption. Illustrated 752
The Hulson Grate. Illustrated.....753
Powers System of Regulation. Illustrated.....754
Catalog Notes 755
Trade Notes 756

BOILER CAPACITY VS. ECONOMIZER

What is the proper amount of heating surface to allow per boiler horsepower is just now a live topic.

Instead of the 8, 10 or 12 sq. ft. formerly considered good practice, designers of large plants are now adopting 4, 5 or 6 sq. ft., experience having shown that this results in high economy of the steam generating plant as a whole.

It has been questioned whether operating boilers at these higher rates will involve danger of burning plates and tubes. Since the temperature of the fire has not necessarily been changed in any way and the rate of heat transmission at the point where the gases first strike the tubes has not been modified, the maximum rate at which the boiler surface transmits heat, and hence the heating of the metal is no greater than before. Only the average rate has been increased.

Under these circumstances the real limit to the capacity of the boiler becomes not the ability to transfer heat, but rather its ability to circulate the water rapidly enough to keep the surfaces wet, and to disengage the steam from the water, problems which are now being attacked and solved successfully by the leading boiler builders.

It is true, however, that the curtailed heating surface will be accompanied by higher temperatures in the flue gases, and although it may not pay to add more boiler surface to recover this heat, it will probably pay to recover it by economizer surface, because of the lower temperature of the contents of the economizer as compared with the contents of the boiler. Also because of the low annual charges upon the economizer surface the gases can be reduced to a temperature nearer that of the water entering the economizer, than when using more boiler surface and no economizer.

The result is that boiler surface can be reduced, efficiency increased and capital charges maintained as before, or reduced, by an intelligent utilization of the counter-current principle as embodied in a combination of boiler and economizer.

WE MAY ASK OURSELVES, What constitutes success? There will be many answers to this, but after all may it not truthfully be said that the largest measure of success lies in the realization in a man's inner consciousness that he has consistently had high ideals of life and purpose, and has with energy and with the utmost of his ability endeavored to make them realities; and also that he has a conscience void of offense? The world is made up of many men of many minds, and no man can hope to conduct himself so as to entirely escape criticism and fault-finding. No matter what his conduct, there will surely be some one who will complain because it has not been otherwise; but happy is that man who has so walked that he need not accuse himself.—Charles Frederick Loweth.

IN THE BUCKEYE STATE

With the Engineers in Convention at Lima, Ohio, June 20-22

IN the face of every delegate, exhibitor and guest as they left the city of Lima, was a happy and pleased expression, indicative of the fact that they had been somewhere worth while. They had good reason, too, for a large and well arranged exhibit, good attendance by the delegates and expeditious transaction of business combined with a wholesome good time were factors which made the Ohio State convention a success and reflected deserved credit upon the members of the Lima association who had charge of the program.

Opening

MEMORIAL HALL served as the home of the convention, affording opportunity for an attractive arrangement of exhibits in the entrance hall and the 2 large rooms which opened from it on each side, while the auditorium furnished an ideal meeting place for the business session and lectures. J. F. Reed, chairman of the convention committee, called the first meeting to order on Thursday morning, introducing as the first speaker, Mayor Shook, who in a brief address extended his welcome to the delegates and was replied to by State President J. J. Coughlin.

Owing to a previous engagement to speak before the Civil War Veterans at Springfield, Gov. Harmon was unable to be present, but delegated Chas. H. Wirmel, chief examiner of engineers, to fill his place before the Lima gathering. Mr. Wirmel told of the benefits to be derived from organization and especially from conventions, relating as a specific instance the elevation of the profession in Ohio during the last 10 yr., the passage of a license law through the ceaseless efforts of the organization under which 16,000 men in the state of Ohio are at present each possessed of an engineer's license, and the enactment of a boiler inspection law which places 20,000 boilers under state supervision.

Other speakers were Prof. D. D. Ewing, Ohio Northern University; E. J. Maire, president of Lima Progressive Association; Judson Pratt, John Lawler, Anthony Deutsch and T. H. Roberts. Reports of the officers were then received and the meeting adjourned for lunch.

At the afternoon session the balance of the routine business was disposed of and the delegates listened to an address by Prof. Ewing, on "Power Plants for Electric Railways," in which he emphasized as the primary requisites of the railway plant equipment, reliability, a large overload capacity, economy in operation and a first cost which is not excessive, and explained as follows the types of prime movers used in such plants.

Turbines and Engines

FOR steam power plants of 10,000 kw. output and larger, the steam turbine stands pre-eminent. The Commonwealth Edison Co., of Chicago, has recently placed an order for a 25,000-kw. turbo-generator, which occupies small floor area, has good economy, unusual overload capacity, is practically free from vibration, operates well on fluctuating loads, has good speed regulation, is efficient over a wide range of loads, is durable, requires a minimum of attendance, and has an exhaust which is free from oil. Owing to the fact that it will operate satisfactorily with high initial pressure, high superheat, and a very low exhaust pressure, boiler space required is much reduced.

As illustrative of the great saving of floor space effected by the use of the steam turbine, it may be mentioned that last year the New York Edison Company placed in its Waterside No. 1 Station, 20,000-kw. vertical steam turbine units, occupying only 298 sq. ft. each.

For smaller alternating-current power plants, there is little choice between the steam turbine and the reciprocating engine. Probably the turbines' greatest advantages are small floor space and freedom of the exhaust from oil; where land is cheap and water plenty these advantages are of little value. The fact that condensers for small and medium size turbines must be tight and large and therefore costly, both as regards first cost and cost of maintenance and operation, will often throw the balance in favor of the steam engine. In some cases the prime movers are run non-condensing, and the exhaust steam is sold for heating purposes in the winter and for the operation of refrigerating machinery in the summer. This is usually more profitable than to run the plant condensing, provided of course that a ready market for the exhaust steam is at hand.

FIG. 1. DELEGATES AND VISITORS AT OHIO STATE CONVENTION

For the direct-current railway plant, the reciprocating engine is usually used for a prime mover, unless floor space is a very important consideration. On the account of commutation difficulties, direct current turbo-generators above 750 kw. output are seldom used, and for the smaller machines the turbine possesses no advantages over the engine except those already noted.

In general the reciprocating engine is more efficient than the turbine when the range of working pressures is above the pressure of the atmosphere, and when the range is below the atmospheric pressure the turbine is the best. Evidently, then, a combina-

tion of the 2 prime movers would be better than either one by itself.

The following example illustrates the advantages of such a combination. A compound reciprocating engine, when operated condensing with 150 lb. initial steam pressure had for its economical load an output of 1350 brake hp., with a steam consumption of 15.5 lb. of steam per brake horsepower per hour. When operated in conjunction with a low-pressure steam turbine, the output of the 2 units was 75 per cent greater and the steam consumption 18 per cent less than that of the reciprocating engine alone when operated condensing.

In regard to the installation of mechanical stokers and automatic coal and ash handling machines, the engineer must always remember, that the sum of the interest on first cost, the cost of maintenance and operation, taxes, insurance, and depreciation must be less than the cost of labor for doing the same work by hand. Many of us are prone to take the over-enthusiastic salesman's word for such things and not figure it out for ourselves.

Thursday evening was occupied with the inspection of the exhibits and an entertainment given by the exhibitors.

National vice-president of the N. A. S. E., conducted the installation following the election.

The aggressive campaign conducted by the Toledo delegation put to rout the other contenders for the 1913 convention and the honor was carried away easily by that city.

In the afternoon the delegates, headed by the McCullough Park band, marched to McCullough Park, where they were entertained by the Lima association with the park amusements, while the visiting ladies were taken on an automobile trip about the city, as guests of the Lima Ladies' Auxiliary.

In Memorial Hall, during the evening, the guests were given a farewell reception, where a dainty luncheon was served by the Ladies' Auxiliary and dancing enjoyed. The exhibits were also kept open and many of the engineers passed the time in inspction of the steam specialties and modern appliances for the power plant.

On View

EXHIBITING a line of engineering specialties the Lunkenheimer Co. occupied an attractively decorated booth, in charge of H. A. Burdorf of Cincinnati. "Renewo" valves for every purpose were displayed, including

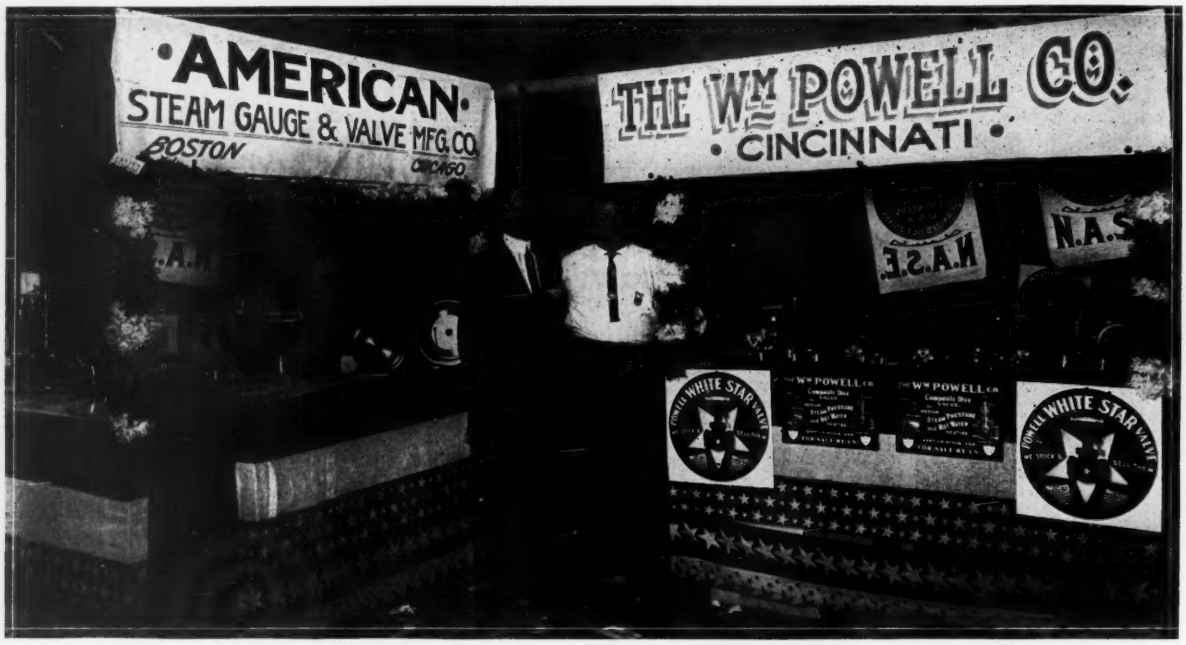


FIG. 2. AMERICAN STEAM GAUGE & VALVE AND WM. POWELL COS'. EXHIBIT

Friday Session

IN accordance with the wishes of many of the delegates who wanted to return to their homes before the end of the week, the remaining business of the convention was disposed of in the Friday sessions, leaving the rest of the time for entertainment and inspection of the exhibits. Following the usual method of succession, T. F. Synnett, of Dayton, was elected president for the coming year. For vice-president J. F. Radigan of Cleveland was chosen, and Mr. Spangler for secretary. The remaining officers elected were: John M. Wirmel, Cincinnati, treasurer; Chas. Flenner, Hamilton, conductor; B. A. Held, Toledo, doorkeeper; T. E. McFadden, Columbus, state deputy. John McGrath, of Chicago,

globe, check, gate, pop safety blowoff, nonreturn, boiler stop, needle and relief, also lubricators, oil cups, grease cups, injectors, cocks and whistles.

NEATLY DISPLAYED in the space of Knopf & Johnson were the Knopf patent automatic piston rod oilers, designed for application to any type of engine. A. L. Cain was the representative of the company.

"INCREASED POWER of transmission by running slack belts made possible by Cling Surface treatment" was one of the arguments presented by F. J. Rhoades at the booth of the Cling Surface Co. Erusa belt dressing, in liquid form and designed especially for dusty conditions, is a new specialty of this company. Actual photographs of all conditions of plants were to be seen illustrating the successful use of both these products.

OIL AND GREASES for automobiles and all forms of machinery and grease cups for every type of bearing were to be found at the booth of the Keystone Lubricating Co. L. L. Lacey, for the company, was there to boost for Keystone grease.

F. P. GIBSON, representing C. E. Squires & Co., had his demonstrating steam trap with him and interested the crowd by pumping water under pressure without losing any of the air.

WESTINGHOUSE ELECTRIC & MFG. CO. interested the ladies with a full display of electric household devices and for the benefit of the engineer showed a line of central station equipment, including meters, lightning arresters and fans. The exhibit was made through Reed Bros. Electric Co., local agents, with S. Z. Falkman as representative of the Westinghouse Co.

EVERY ENGINE'S DOIN' IT was the slogan over the booth of the Hooven-Owens-Rentschler Co., where a steam cylinder of the Hamilton-Corliss engine was in action, showing the valve gear with the new trip plate mechanism and the latest type of gravity Corliss valve. The new patented valve packing was among the other features demonstrated by L. A. Springer, the company's representative.

REX SHEET packing for superheat, style 1902 sheet, Lip hydraulic for outside packed pumps were among the varied lines of packings shown by the Crandall Packing Co. J. M. Chapman and J. C. Stout were in charge. The packing cabinet presented to the Lima association by the Crandall Co. attracted much attention.

FIG. 3. H. W. JOHNS-MANVILLE CO. BOOTH

DANIEL'S P. P. P. ebonite sheet packing, P. P. P. rod packing in 3 styles, "Regular," "Special" and "Marine," and each style in coil, spiral, and ring forms, Valvolite twist packing and Hercules hose made in compositions for water, oil and steam, made up the display of the Quaker City Rubber Co. Geo. Thompson was there to do the explaining.

WHITE STAR, Model Star and Union disc valves constituted the main features of the exhibit of The Wm. Powell Co., with Chas. Cullen doing the advertising. Among the other features were the Powell oilers, grease cups, and the Trojan lubricator for feeding cylinder oil.

WHAT'S THE TIME? It was only necessary to look at that demonstrating recording gage in the booth of the American Steam Gauge & Valve Co., and the question was answered accurately. Other instruments of interest in this display, which was in charge of C. S. Kiessling, were American Thompson indicators, steam gages, pop safety valves, Ellison draft gages and the Ellison throttling calorimeter.

PROMINENT among the devices shown by the Lagonda Mfg. Co. of Springfield, Ohio, were the Weinland boiler tube cleaners with the quick repair heads for rapid substitution of new cutters, Lagonda multiple strainers and automatic cutoff valves. The representatives in charge were F. H. Field and Byron Haver.

FIG. 4. SQUIRES DEMONSTRATING STEAM TRAP

PACKINGS for every use were to be seen in the space occupied by the Anchor Packing Co., including the coil, spiral and sheet types, gaskets and pump valves. In charge of the booth were E. A. Smith, A. F. Jerbee and R. W. Becker.

JENARCO sheet packing, '96 packing, gaskets and union rings were among the many styles of packing shown by Jenkins Bros. Also of interest were the pump valves, angle, cross, and gate valves with the composition removable discs which obviate regrinding. C. G. Beckwith, Frank Martin and H. C. McLaughlin were always at hand to explain the Jenkins product.

SAMPLES of oils of all grades, graphite grease and Polarine were shown by the Standard Oil Co., G. H. Bouscay, manager of the Lima office, being in charge.

NATIONAL ENGINEER was represented by J. W. Lane.

IN THE BOOTH of the Ohio Grease Lubricant Co. was shown the Ohio Grease lubricator designed for feeding a hard oil made in 5 different brands for varying speeds and temperatures, being kept at the proper consistency in the lubricator by means of a steam jet. A. J. Wheelbarger was always ready to explain the mechanism.

HOME RUBBER CO. was assigned a booth, but its display did not arrive in time to be put on exhibition.

SEVEN DIFFERENT grades, a grade for every type of bearing, were placed on display by the White Star Refining Co. S. C. Cook, mgr. of the grease dept., was present to explain their qualities and methods of application.

"DEARBORN METHODS" was printed on the leather sign over the Dearborn Drug & Chemical Co.'s booth and were demonstrated by the pleasant reception given the visitor by the men in the booth, E. H. Ruhlman, D. Delaney and P. T. Payne.

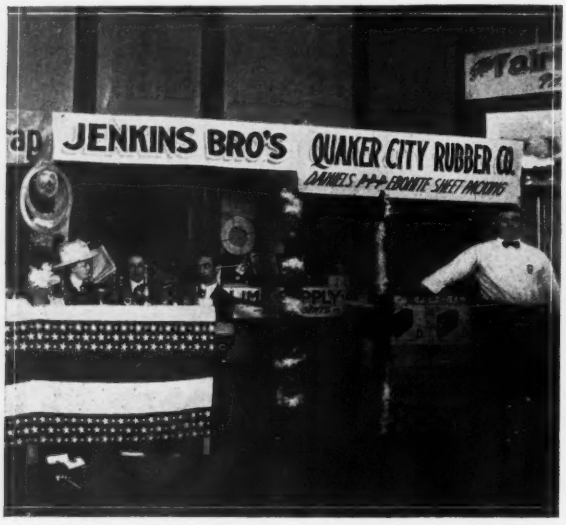


FIG. 6. JENKINS BROS'. AND QUAKER CITY RUBBER CO.'S DISPLAYS

IN SERVICE for 14 yr. was the record of the samples of old packing taken from a feed pump, which were to be seen at the Garlock Packing Co. space. Charles J. Carr stood by to explain that this was but a typical illustration of Garlock service.

Dean tube cleaner by section. H. J. Krampe and W. J. Stephan represented the company.

BY THE BRICK is the way Hawkeye compound is sold. G. A. Shaw, in the Hawkeye Compound Co. booth, vouched for its effectiveness, also for the special com-

FIG. 7. LUNKENHEIMER SPECIALTIES

pounds for cleaning feed water pipes, prevention of pitting and prevention of foaming.

THOSE J-M SEA RINGS were the object of much attention at the exhibit of the H. W. Johns-Manville Co. They were shown packed in section, illustrating how they exert

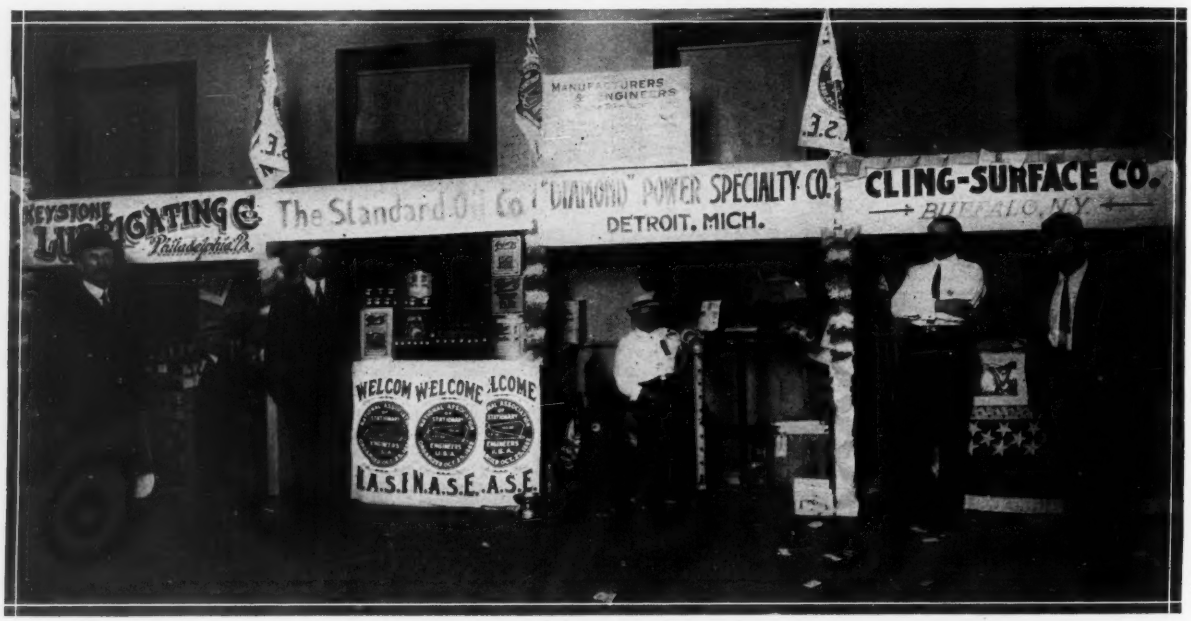


FIG. 5. KEYSTONE GREASE AND CLING SURFACE

"DIVIDENDS FROM SOOT," was the title of a booklet obtainable at the booth of the Vulcan Soot Blower Co., where the engineers registered for a chance on a free Vulcan soot blower. The operation of the blower was shown by means of a model, and the construction of the

pressure on the piston only when pressure is exerted upon them by the steam. J-M metallic, round, coil and spiral packings were among the other types shown. E. E. Skinner and C. E. Cox were in charge.

ACCESSIBILITY was one of the main features demon-

strated by the section of the Model D steam trap shown by the V. D. Anderson Co. A full line of round and oblong seamless copper floats were also shown. The representatives were J. H. Meyers and R. E. Bronson.

ARROW BOILER COMPOUND CO. occupied a prettily decorated booth and made a favorable impression by the courteous treatment given the visitors. E. M. Swindler and F. A. Foster were in charge.

BARTON STEAM TRAPS in an attractive arrangement formed the display made by the Automatic Steam Trap and Specialty Co.

A WORKING model of the Wickes vertical water tube safety steam boiler equipped with a glass drum to demonstrate the efficient circulation, occupied the space of the Wickes Boiler Co. of Saginaw, Mich., and James Milne was the man who did the stoking.

NOT PATENT NUMBERS but style numbers are 1, 19 and 8 indicative of the patented styles of Belmont packings for steam and ammonia which formed the nucleus of the exhibit of the Clement Restain Co. Other styles in round and square forms were also shown. E. L. Parker was the representative in charge.

JOHN HARLEY was in charge of the exhibit of the Diamond Power Specialty Co., in which was shown the Diamond soot blower made for use with any type of boiler. Mr. Harley also had on exhibition his new patented pump designed for boiler feed, vacuum and, in fact, every variety of pump service.

AMONG THE STEAM specialties with the circle 4-S trademark displayed by the Strong, Carlisle & Hammond Co. of Cleveland were reducing valves, the Strong steam trap with the ball valves and the Strong pump governor and pressure regulator. Homer Whelpley was the representative.

VALVES OF ALL TYPES, Dart unions and flanges, asbestos packed cocks, the Fairbanks wrench and Sphero ball valves were under the care of J. A. Taft at the booth of the Fairbanks Co. of Pittsburgh.

MANHATTAN for hydraulic work, Palmeto in braided, round, and square forms for all steam and air pressures, Greenet gasket tubing and the Favorite reversible ratchet wrench were the subjects of discourse by B. M. Bulkley, for Greene, Tweed & Co. "When you find a good thing, stick to it," was his text.

STEEL MIXTURE was in prominence with a model boiler setting and samples of interlocking fire brick blocks and special settings for boiler door arches and back combustion chamber arches. C. M. Morgan and J. A. Spencer were the representatives for the McLeod & Henry Co.

EMPIRE STATE CONVENTION

Engineers of New York State Meet at Yonkers

THE 17th Annual New York State Convention of the National Association Stationary Engineers held at Yonkers, June 14 to 16 will rank among the most highly successful events held by state organizations. This assertion is justified by an unusual event that happened before the closing hours. A paper was presented to the local committee signed by all the exhibitors, expressing appreciation for complete arrangements made for their benefit and for courtesies extended during the convention. Complete satisfaction, with general good results, was further in evidence by a unanimous vote of the convention to hold its meeting at Yonkers in 1913.

The convention was officially opened at the armory on Friday morning by Charles H. Graham, chairman of the Local Committee; he introduced the first speaker, Mayor James T. Lennon, who extended to the visiting delegates a most hearty welcome and the freedom of the city.

National President Edward N. Kearney responded to the Mayor's welcome, and complimented the committee in charge for the very excellent preparations made and the exhibitors for surpassing the many exhibitions he has had the privilege of attending.

Postmaster Nathan A. Warren, the next speaker, addressed the meeting as Chairman of the Chamber of Commerce, and State Deputy James R. Coe responded to Mr. Warren's speech. Campbell Scott, Manager of the Yonkers Branch of the Otis Elevator Co., was next introduced, and spoke at length and interestingly on the varied industries of the city. George O. Kaley, State vice-president, was the last speaker expressing regrets for the absence of Past President Joseph F. Carney, who was unable to be present.

At 1 o'clock about one hundred of the delegates visited the plant of the Otis Elevator Co., and after a thorough inspection of the different departments of that vast establishment, were entertained at luncheon in the company lunch room, at which women employed in the factory acted as waitresses.

During the afternoon and evening the exhibit hall was crowded to its full capacity by visitors. The day's entertainment was completed by 2 hr. of excellent vaudeville given in the main hall by the New York Bunch under the direction of Frank Martin.

At 10 a. m. on the 15th the second regular session of the convention assembled, the most important business being the election of officers. The meeting was presided over by State Vice-president George O. Kaley, and every delegate being present and seated, the nomination and election of officers was then taken up, with the following results: President, George O. Kaley, Brooklyn; Vice-president, Charles B. Vradenburg, Rochester; Secretary, E. E. Pruyn, Rochester, re-elected; Treasurer, William Downes, New York City, re-elected; Conductor, Elmer Hartley, Niagara Falls; Door-keeper, J. T. Fitzgerald, Little Falls; Chaplain, J. H. Gregory, Buffalo; State Deputy E. J. Gilroy, Buffalo; Legislative Representative (at Albany) E. J. Lee, Albany. The office of Legislative Representative is practically a creation of this convention; the duties of the office being to assist the Standing Committee on State License.

Election of officers being completed, addresses were made by National President E. N. Kearney, and Past-President Joseph F. Carney. The remarks of both speakers were received with much enthusiasm and evident appreciation. The doings of the day were brought to a close by a band concert in the evening by Prof. Moynihan's Military Band.

The last day of the convention was ushered in cloudy and rainy, much to the disappointment of the many who had prepared to attend the excursion by boat to New York Bay under the auspices of the Chamber of Commerce.

At 10 o'clock the last meeting of the convention was held, the business in order being the installation of officers, by Past National President W. J. Reynolds, Past State President Schabacker acting as Conductor; a feature of this meeting was an address by a member

of the Ladies Auxiliary of New Jersey. While speaking of ladies, we must not forget the activity of Number 5 of Brooklyn, which had a booth at the convention and whose energetic members laughed, tagged and separated every man in sight from his price for a tag. The sum total of this onslaught was $250 in cold cash, to be turned over, we understand, to the pension fund.

The inevitable, but always more or less interesting performance of having the delegates and their friends photographed was now in order. Sympathy is herewith extended to the ladies whose hats, and to the men whose sox didn't get within range of the camera; the picture was so unintelligible that we spare the feelings of those misrepresented by it, and do not publish it.

At 2:30 p. m. delegates and friends, about 300 of them, boarded the steamer Ben Franklin as guests of the Chamber of Commerce, and enjoyed a pleasant afternoon trip down the Hudson, around New York Bay and returning to Yonkers about seven o'clock.

The Exhibit Hall

McVicker Scientific Boiler Compounds by the Wm. B. McVicker Co., 115 Broadway, New York, made an interesting exhibit, including also Elevator Emulsion, soap powders and high-grade lubricants. John J. McDonald, in charge.

Cling-Surface Co., Buffalo, N. Y., had its usual demonstration outfit, which has become familiar to engineers all over the country, showing how Cling-Surface works; operated by Chas. F. Chase and Geo. H. Moon.

The Wm. Powell Co., Cincinnati, exhibited the well known White Star, Union Disc and Model Star Valves; Trojan, Crescent and Neptune Lubricators; Cyclone Blowoff Valves; Signal and Puritan Oil Cups; Renown, Colonial, Bruno and Coin Grease Cups, and Titan and Ready Throttle Valves. J. G. Zolleis of the H. Mueller Mfg. Co., Eastern Agents, dispensed information about these products.

American Huhn Metallic Packing Co., New York, flagged the passer-by by means of a tall sign, similar to those at railroad crossings, reading "Stop! Look! Listen!," and a miniature upright engine in operation served to center the attention upon the exhibit of Huhn Metallic Packing, D. L. Sheet Packing and D. L. Black Sheet—"D. L." standing for square deal. L. R. Gracey and A. C. Judd, in charge, held forth eloquently upon the merits of those products.

York Manufacturing Co., York, Pa., represented by Shipley Construction & Supply Co., New York, distributed literature describing its Ammonia Fittings, Ice Machines and Anhydrous Ammonia. Wm. G. Narath and James Westberg in charge.

Boig & Hill, New York, showed a complete line of engineering specialties, including Water Level Regulators, with W. W. Boig in charge.

For stopping leaks of steam and hot and cold water Smooth-On Manufacturing Co., Jersey City, N. J., had an impressive exhibit of Smooth-On Engineering Cements, also Smooth-On No. 7 for stopping leaks in concrete and for setting fire brick, and Smooth-On Gaskets for flanged pipe joints. Vreeland Tompkins, of the company, was in charge.

The Platt Iron Works Co., Dayton, Ohio, exhibited Smith-Vaile and Stillwell-Bierce steam pumps, also high and low lift centrifugal pumps. Geo. W. Neff in charge.

Washburn & Granger, New York, represented by Roger Granger, D. M. Granger and M. J. Deegan, were showing Dean Grates for high pressure water and horizontal tubular boilers.

Westchester Lighting Co. were boosting Gas Industrial Fuel, showing its application by means of a Backus gas engine in operation.

H. W. Johns-Manville Co., New York, had a display of its full lines of packing, including Automatic, Sea-Rings, Permanite, Sheet, Kearsarge Rings and Gaskets and other packings covering all conditions of service. B. C. McClure, Manager of the Packing Department, and H. T. Lyman were in charge.

Power was represented by Messrs. Dibble, Robbins, Buxton, and Armour; National Engineer by Chas. T. Ceilley; Southern Engineer by Messrs. Smith & Warren; Practical Engineer by Messrs. Henderson and Kershaw.

F. W. Webb Mfg. Co., Boston, Mass., displayed Webco Unions, the advantages of which were explained in a convincing way by F. B. Potterton.

J. E. Kennedy, New York, showed lift and force pumps for plumbers and household use.

Jos. C. Ryan, Yonkers, N. Y., had an exhibit of engineers', contractors' and mill supplies, the prominent features of his display being Dixon's Graphite Lubricants, and Triple Sheet Packing made by the Gutta Percha & Rubber Mfg. Co., of New York.

C. T. Coe & Co., New York, displayed the Coe Patent Sectional Shaking & Dumping Grates.

Jenkins Bros'. space was devoted to the display of a complete line of Jenkins valves and mechanical rubber goods. Everybody was pleasantly greeted by Frank Martin, C. B. Ohlsen and D. E. Utz, in charge.

The Chapman Valve Mfg. Co., of Indian Orchard, Mass., represented by C. F. Webber and F. W. Sleep, the New York Manager, showed the Chapman Standard and Extra Heavy Valves.

Buhne Metal Packing Co., New York, called attention to its Fibrous Babbit steam packings, which were highly recommended by C. L. Johnson.

Samuel Lewis, New York, displayed Wrigley's Patent Flexible Drain Pipe Cleaner and "Wondermop."

J. E. Pawson & Co., Yonkers, N. Y., had an interesting exhibit of Barrett's Specification Roof.

New York Belting & Packing Co. occupied a prominent position with its Indestructible Ruby and Firo Sheet Packings, Cobb's Packing, Crocoite, Graphon, B. & P. Asbestos, Magic and Flax Hydraulic Packings; also B. & P. Asbestos and Rubber Moulded Gaskets. L. H. Young and F. N. Anderson ably presented the merits of these goods.

Estate E. R. Ladew, New York City. This exhibit attracted unusual attention because of a demonstration outfit which was constantly in motion to show the company's Turtle Belt—a waterproof leather belting. Richard Golden, in charge, had a catching smile and a convincing way.

J. L. Quimby & Co., 278 Water St., New York, showed Lubricating Oils and Compounds for all purposes.

The Homestead Valve Mfg. Co., Pittsburgh, Pa., presented a line of Homestead 3-way and 4-way Valves, Angle and Straightway Valves, Homestead locking cocks and blow-down valves for marine and stationary boilers. Frank Boyle was in charge.

The V. D. Anderson Co., Cleveland Ohio, exhibited the Anderson Model D steam traps and reinforced floats. L. A. Couch and H. S. Meacham in charge.

The Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y., occupied a double space to show its complete line of pressure temperature and speed instruments. A large display board made this a particularly noticeable and attractive exhibit. Birger P. Nissen, in charge, did justice to these meritorious products.

The Garlock Packing Co. made a display of high and low-pressure spiral packings, asbestos gaskets, flax packing, hydraulic pump valves and metallic packings; also its No. 900 high-pressure sheet and No. 22 Red Sheet. F. C. Bulkley, of the New York Office, was in charge.

Dearborn Drug & Chemical Works distributed literature describing Dearborn Scientific Feed Water Treatment through Messrs. Gilbert H. Reilly and Thos. H. Platt, of the New York Office, in charge.

It is safe to say that no single exhibit attracted more attention that that of the Hewes and Phillips Iron Works, of Newark, N. J., where there was shown a working model of their latest high speed Corliss engine and Franklin patent Horizontal, Gravity-Latch, Releasing Valve Gear.

Green Fuel Economizer Co., Matteawan, N. Y., distributed a great variety of unusually attractive literature describing its economizer and draft apparatus and installations, and exhibited a small model.

The C. E. Squires Co. showed a working model of the Genuine Squires Steam Trap. This exhibit was always surrounded by an interested group. J. B. Boyer, in charge of the exhibit, said that the working model told the story so completely that there was not much left for him to say.

Chas. De Ved, Merchant Engineer, New York, was enthusiastic about Vulcan Soot Cleaners, Trill Indicators and Dean Tube Cleaners; which formed his exhibit.

Eddy Valve Co., Waterford, N. Y., displayed the Eddy Gate Valve, iron body bronze mounted, and Eddy Bronze Valves for both steam and water. Harry A. Holmes was in charge.

The Underfeed Stoker Company of America distributed printed matter in regard to the Jones Underfeed Stoker, and J. V. Ryan in charge, showed convincing photographs of how the Jones does the work.

Fuel Engineering Co., of New York, Consulting Fuel Experts, had attractive literature for all who were interested, with W. G. Borner in charge.

Millard F. Smith Co., New York, occupied a double space with a complete showing of Jefferson Unions; also Ohio In-

jectors, globe valves, lubricators and grease cups. N. C. Smith in charge.

HAWK-EYE COMPOUND CO., Chicago, gave engineers something to make them think about dry compound in the form of bricks. J. P. Everett in charge.

ALBANY LUBRICATING CO., Adam Cook's Sons, Proprietors, New York, took advantage of the opportunity to remind engineers of its product by means of huge piles made of cans of Albany Grease, and also displayed its grease cups, etc. M. V. Peavey and J. Sheer emphasized the golden value under the yellow label.

PEERLESS RUBBER MANUFACTURING CO., New York, was on hand as usual with a large showing of its mechanical rubber goods, including the famous Rainbow Sheet and Stem Packings with Rainbow core, Hose, Valve Packings, etc. A pipe smoke rewarded those who stopped for a pleasant chat with C. F. Heitzmann and Holland L. Browne, Jr., who were in charge.

INTERNATIONAL ACHESON GRAPHITE CO.'s exhibit was always the center of an interested crowd, a model of an electric furnace such as is employed in making Acheson Graphite being a strong drawing card. The products shown were Oildag, Gredag and Aquadag. Samples were shown of graphite suspended in thin oil and in water. G. M. Barnes and H. E. Poeller were in charge.

HOME RUBBER CO., Trenton, N. J., were showing their H. P. H. Hydraulic Packing and their N. B. O. Sheet. Wm. J. Schatz talked tirelessly and convincingly about the merits of these products, laying special emphasis on the H. P. H. which stands for high pressure hydraulic.

HEINE SAFETY BOILER CO., St. Louis, in the copies of its bulletins, Boiler Logic, discussed boiler design and construction, and Superheater Logic, discussed the design of superheaters and their operation. Harold A. Brangs in charge.

CRANDALL PACKING CO. exhibited its full line of packings in charge of H. A. Forward.

THE MURPHY IRON WORKS, Detroit, Michigan, furnished its booth to demonstrate the points of advantage of the Murphy Stoker.

OTIS ELEVATOR CO., Yonkers, N. Y., made a display of Special Elevator Grease and Oils, Electric Controllers and parts, Eggler Lubricators, H. Voorhees being in charge.

SKINNER & CONNOLLY, Yonkers, N. Y., made an exhibit of Skinner's Gauge Glass Cutter.

THE PHILADELPHIA GREASE Manufacturing Co., Philadelphia, was represented by Richard D. Jackson, showing Philadelphia Grease and Jackson Grease Cups.

AMERICAN STEAM GAUGE & Valve Mfg. Co., Boston, had an attractive display of American Deadweight Gage Testers and Original American Thompson Steam Engine Indicators. W. Wagner in charge.

CLEMENT RESTEIN CO. was in evidence with its Belmont Packings for steam, water, air and ammonia.

GREENE, TWEED & CO. were there with their well known Palmetto Packings and the hall was filled with its little chirper souvenirs.

DURYEA MANUFACTURING CO., New York, had a machine which demonstrated its Wooster Belting and its lubricating oils at the same time. This company also displayed Armorite Belt Dressing and Detergine, a nonexplosive substitute for benzine. B. L. Duryea and L. R. Bornstein were in charge.

A BOOTH which attracted a great deal of attention because of its unusual display was that occupied by the Knickerbocker Smokeless Coal Co., in which was a lump of coal about 3 by 6 ft., decorated with pick axes which gave mute invitation—often accepted—to stop and chip a piece off the block of coal.

THE LUNKENHEIMER CO., of Cincinnati, made a good showing of its well known engineer specialties, including Renewo Valves, a new nonreturn boiler stop valve, and their Duro Blowoff Valve. W. A. Reynolds and A. S. Phillips were in charge.

THE LESLIE CO., Lindhurst, N. J., made a display of the Leslie Pressure Regulators.

FOX'S HARDWARE STORE, Yonkers, N. Y., made a display of mechanical tools, including the well known Starrett products.

MANNING, MAXWELL & MOORE displayed the products of the Ashcroft Mfg. Co., Hayden & Derby Co., Consolidated Safety Valve Co., and Hancock Inspirator Co. Frank Corbett and staff in charge.

THE IRON WORKS CO., Jersey City, N. J., represented by Gilbert McGillivray, distributed literature descriptive of the Crowe Chain Grate Mechanical Stoker.

KEYSTONE LUBRICATING CO., Philadelphia, Pa., made its usual comprehensive showing of Keystone Grease (The red Keystone on the blue can), in various densities for all classes of machinery for which lubricant is used. J. M. Potts in charge.

THE LAGONDA MFG. CO., Springfield, Ohio, one of the first exhibits on entering the hall, made an attractive display of the Weinland Tube Cleaner, Lagonda Enterprise Strainer, Automatic Cutoff Valve and Lagonda Sterling Boiler Cleaning Devices.

DODGE MFG. CO. had a large exhibit of power transmission machinery with a demonstrating outfit in operation showing both the Solid Orton and the Dodge Split Friction Clutches. W. C. Miller, New York, in charge.

HARRISON SAFETY BOILER WORKS, Philadelphia, made liberal distribution of attractive literature describing its new Multi-port fool-proof back pressure valve, Cochrane Heaters, the new Cochrane Metering Heaters, and Oil and Steam Separators. C. Williard in charge.

M. T. DAVIDSON & CO., Tribune Bldg., New York, distributed catalogs and other printed matter on its steam pumps and condensers; John Lowe in charge.

AMERICAN ENGINE CO., Bound Brook, N. J., distributed catalogs and other literature descriptive of the various types of American Ball Engines, especially the Angle Compound.

CORALLINE DRUG & CHEMICAL CO., New York, made an impressive exhibit of large steel drums, which are the containers in which Coraline is shipped; Chas. F. Winn in charge.

PITTS & KITTS MFG. & SUPPLY CO., New York, displayed products of a number of concerns which it represents in New York, New Jersey and Pennsylvania. Among such products were the Patterson-Allen new Forged Steel Valves; Cassidy Everlasting Safety flue blowers, to replace rubber hose, Everlasting Blowoff valves, McCord Force Feed lubricators, McKim Gaskets, Kitts Safety Feed Water regulators, Barton Automatic Expansion Steam traps, Northern Self-closing Safety water gages, Northern Extra Heavy Bronze gage cocks, Perolin German boiler compounds, Durabla Asbestos sheet packings and Durabla gage glasses; Wm. S. Pitts, Willard A. Kitts, Jr., and C. H. Doyen in charge.

THE LADIES' AUXILIARY ASSOCIATION, No. 5, Brooklyn, N. Y. tagged everybody at least once and collected whatever the taggee chose to contribute to the Pension Fund of the New York State Association. The ladies also held forth in one of the booths with soft drinks and light refreshments, and it is reported that they did a very profitable business.

ALBERGER EXPANSION JOINTS and feed water service heaters with the new spiral flow tubes were shown by the Alberger Pump & Condenser Co., of New York, G. P. Taylor being in charge.

BOOSTING THE BLOWERS was the business of John R. Robinson, of New York. He was explaining the advantages and operation of the Bayer Steam Soot Blower and the Marion Blower.

POWER MOTORS driven by air, steam or water and in turn driving Roto boiler tube cleaners and condenser tube cleaners were the attractive showing in the exhibit of the Roto Co., Hartford, Conn. Devices were also shown for polishing and reseating boiler tube caps and headers, by Theodore Kalisher, in charge of the exhibit.

TUBE CLEANERS for all kinds of horizontal return tubular boilers were demonstrated by a model showing the operation of the devices of the National Fuel Cleaner Co., of Trenton, N. J. Otto Donatz and H. R. Strauss, were in charge of a very large corner space.

THE HEART OF THE OIL SYSTEM namely the Hart force feed oil pump was displayed by the Sherwood Mfg. Co., of Buffalo, N. Y., in charge of J. H. Madden, there was also a display of engine and boiler appliances in brass and bronze.

FIRMS HAVING SPACE at the exhibit but not represented or displaying goods were John A. Roeblings' Sons Co., of N. Y., Ashton Laird & Co.; Engineers Mill & Supply Co.; Power Specialty Co., of New York; J. O'Mera, Alston and Portlanf Cement Works, New York; Erie City Iron Works, Buffalo, N. Y.; American Tool & Machine Co., Boston, Mass.

EDWARD E. ASHLEY, JR., and Alfonse Kaufman have opened an office as consulting engineers under the name of Ashley & Kaufman at 14 International Amphitheatre, Union Stock Yards, Chicago, Ill. This is a branch of the New York office and will be in charge of John Fallon, formerly of the Tennessee Copper Co. Messrs. Ashley and Kaufman have recently been retained as consulting engineers on the heating, lighting and sanitary engineering for the Union Stock Yards and the central manufacturing districts of Chicago.

STUDY THE MAN for whom you work, get acquainted with his methods. Then study your machine. Get all you can out of it. Combine your studies and you have a recipe for a fat pay envelope.—Canadian Manufacturer.

IN THE BLUE GRASS

Hospitality and a Fine List of Papers at Owensboro, Ky., Convention

TRADITIONAL hospitality of Kentucky, was ably demonstrated at the tenth annual convention of the Kentucky State Association of Stationary Engineers held at Owensboro, June 14 and 15. The educational papers and talks given before the delegates, an excellent exhibit by the supply men and the adoption of an outline for concerted work for the licensing of stationary engineers, placed the meeting high among the state associations.

Business sessions and the exhibit were held in the state armory hall and were attended by numerous visitors aside from the delegates. The opening session was held Friday morning with State President J. H. Oelze as the presiding officer. Mayor Lambert welcomed the delegates to the city and presented them with those well worn keys, and F. W. Rauen replied, giving a short talk on the educational value of the association. Geo. H. Cox, president of the Owensboro Business Men's Association then addressed the meeting with "Our City" as his subject. At conclusion of the morning session the exhibit was formerly opened by Chas. Cullen who led the audience in singing "My Old Kentucky Home."

At 2 P. M. the delegates again went into business session in which were received the reports of the officers and committees. The principal social feature of the convention took place in the evening in the form of a moonlight excusion on the Ohio river by the delegates and visitors aboard the steamer "Golden Girl" and barge.

Saturday Session

IN the session Saturday the following officers were elected and installed: President, J. L. Shrode, Hopkinsville; vice-president, C. C. Carroll, Louisville; secretary, J. R. Morris, Hopkinsville; treasurer, Ed. Kochenrath, Louisville; conductor, J. H. Stamfer, Lexington; doorkeeper, J. N. Draper, Henderson; state deputy, T. Hopkins, Louisville. Hopkinsville was selected as the convention city for 1913, the date being left to the convenience of the Central States Exhibitors Association.

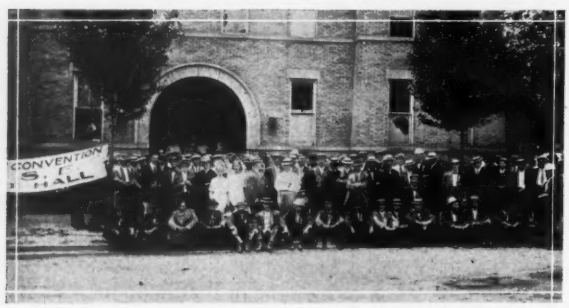


FIG. 1. DELEGATES AND VISITORS AT OWENSBORO, KY.

The license law question was taken up and the following program adopted as a basis for work during the coming year:

The Chairman shall subscribe for at least 6 daily newspapers of Kentucky which will, as near as may be possible, give the news of the state. From these papers and from any other source at hand he shall compile a record of all boiler explosions, flywheel explosions, and other power plant accidents.

On the first of each month he shall send to all the daily and weekly newspapers of the state a compilation of all the troubles of power generation giving the loss of life also the monetary loss and the cause of said trouble. Said report to be prepared in such a manner that it will be acceptable as reading matter.

He shall investigate personally as far as possible all accidents as above in order that his information may be at first hand. He shall in this monthly report also report the progress being made by other states in reference to the passage of license law. To provide for the expense of this work the sum of $100 is appropriated from the treasury which shall be held by the state treasurer subject to the call of the chairman of the license committee and to be paid to him when proper bills are presented.

FIG. 2. THE NEW OFFICERS OF THE KENTUCKY STATE ASSOCIATION

E. H. Breidenbach read a paper describing the water softening plant installed at the Owensboro municipal water works in December, 1911. The water, which is pumped from deep wells was formerly unsuitable for steam purposes, but since the installation of the softening plant, manufacturers have found the softened water quite satisfactory.

The water softener proper consists of 3 fundamental features comprising:

1. Chemical tanks and regulator.
2. Softening tanks for mixing raw water and purifying chemicals.
3. Sedimentation basins.

The water is piped from the wells directly into the softener. It enters through the inlet weir box between the first 2 softening tanks and passes through 3 Sutro weirs of 1,000,000 gal. a day capacity each, and into softening tank No. 1. The flow in softening tank No. 1 is downward, thence through an opening in the base of the partition wall between Nos. 1 and 2, upward in No. 2, thence through a sluice gate into No. 1, downward in No. 3 and into the lower portion of No. 4, thence upward to the sluice gates at each side of the softening tank No. 4. When operating at rated capacity, the water takes 1 hr. to pass from the inlet of softening tank No. 1 to the outlet of No. 4. The arrangement of softening tanks, sluice gates, agitators, etc., is such that the plant can be operated as a single unit, or as 2 distinct units, either simultaneously or separately.

The chemicals, lime and soda, used in the purification are applied at the top of softening tank No. 1. During its flow through the softening tanks, the mixture of water and chemicals is subjected to continual agitation, supplied by 4 sets of agitators, each set consisting of 4 agitators. These 16 agitators are driven from 2 shafts, the power being furnished by 2 2-hp. back-geared electric motors. As one motor furnishes sufficient power to drive all of the agitators, the extra motor is kept in reserve.

From softening tank No. 4 the water is distributed through the sluice gates into distributing channels, the outlet passages from each of the channels consisting of 21 spiral riveted downtake pipes . These deliver the water to the lower portion of each of the settling basins in which the flow is outward toward the excelsior filter.

In its flow across the settling tank, practically all of the precipitate settles out, so that these excelsior filters, placed just before the water passes to the outlet, have little work to do.

The accompanying table shows the composition of the water before softening. For convenience in comparison, the analysis of the softened water is also included.

Municipal Water Softening Plant.
Owensboro, Ky.
Samples taken Jan. 1st, 1912.

	Raw Water	Softened Water
Calcium carbonate	9.52	2.61
Magnesium corbonate	4.25	....
Magnesium sulphate	0.09	....
Magnesium hydroxide	....	0.81
Iron oxide, Alumina	0.18	0.06
Silica	0.46	0.39
Suspended matter	0.90	....
Incrusting solids	15.40	3.87
Sodium sulphate	2.22	1.81
Sodium chloride	0.89	1.03
Sodium hydroxide	....	9.30
Non-incrusting solids	3.11	3.14
Free carbon dioxide	0.51	....
Half bound carbon dioxide	6.41	....
Volatile matter	6.92	....

Results expressed in grains per U. S. gallon.

In the purification there is 1645 lb. of lime and 16½ lb. of soda per million U. S. gallons. The chemicals are purchased and delivered at the softener at the following prices f.o.b. Owensboro, Ky.:

Lime, $4.50 a ton, Soda, $20 a ton, making the cost of chemicals for purification $3.95 per million gallons.

The chemicals before use are stored on the second floor of the main building, and are conveyed by hand truck from the scales to the charging room. In practice 2,000 lb. of lime at a charge is slaked in each of the steel lime slaking tanks, which are located immediately beneath the charging floor. With the type of slakers in use, it is unnecessary to crush the lime. Lumps of the size as they come from the kiln being readily handled.

Among the other papers read before the convention were: "Engineering in a Small City" by C. D. Scott; "The Benefits of a License Law in Kentucky," by W. H. Corwin; "Our Educational Work" and "Self Reliance, the power behind many successful lives," by Frederick L. Ray.

At the close of the meeting the delegates and guests assembled at the annual barbecue and fish fry which took place in the large yard adjoining the convention hall. The afternoon was spent in getting a final look at the exhibits and visiting places of interest about the city.

The Exhibits

RIGHT FROM THE MINES was the large chunk of graphite seen at the display space of the U. S. Graphite Co. There were also samples of scale removed mechanically from boilers through the use of the amorphous graphite. W. C. Skaden was present to explain the action and demonstrate the advantages of the amorphous formation of graphite.

VISITORS were always sure of a welcome at the booth of the Dearborn Drug & Chemical Co., where instructive literature was on display. P. T. Payne passed it out and explained anything they wanted to know about the use of boiler compound.

EVERYTHING ASBESTOS was shown on the big panel display cabinet by the H. W. Johns-Manville Co. Imitation wood, pipe coverings, for water and steam lines and refrigerating piping, spiral, round, square packings, and tubular gaskets were among the many things to be seen at this booth. F. S. Fenton, Jr., and P. J. Schroeder represented the company and entertained the visitors.

THAT DEMONSTATING STEAM TRAP was working for C. E. Squires & Co., and always attracted a crowd by its efficient work. F. P. Gibson kept the trap in working trim, did the talking and took the orders.

ONE OF THE LARGEST displays in the hall was that of Schaeffer & Budenberg with W. H. Shenton in charge. Columbia recording gages and thermometers, S. & B. tachometers, gage glasses, gas analysis sets and draft gages were the principal objects of attention to the visitors who kept the representative busy explaining them all.

SECTIONAL SAMPLES showing the protected seal of the No-cut valve gave the visitor an opporunity to see its operation. These valves were displayed in all sizes by the Osborn Valve & Joint Co. with W. L. Osborne, as demonstrator.

JENKINS BROS. filled its space with a complete assortment of the familiar Jenkins valves with the composition metal discs. M. S. Scott was there in the interests of the company.

CRANDALL PACKING CO. exhibited its varied line of packings for all purposes including diagonal, round, square, sheet and Lip packings as well as gaskets of every variety. The booth was prettily decorated with large ferns. F. M. Wheeler represented the company.

W. H. NEILL & Co., of Louisville, exhibited a full line of packings, rubber goods, belting, belt lacers, and valves. F. J. Hofacker was the representative.

GUENTHER-WRIGHT MACHINE CO., of Owensboro, occupied a space in which were displayed motor boat engines of various types, belting, and small gasoline engines.

WEINLAND air-driven cleaners for cleaning boilers and condenser tubes, either straight or curved were on exhibition at the booth of the Lagonda Mfg. Co. The automatic cutoff valve received notable attention. With this valve on a steam line a break in the steam line or abnormal flow closes the valve, thus presenting a safeguard in case of accident. W. S. Hawes was in charge.

F. S. DODGE was in charge of the booth for the Hawkeye Compound Co., distributing circulars in which were enumerated the merits of the Hawkeye product.

CHAS. CULLEN had charge of the White Star valves made in all types of angle, gate, cross, check ,and globe valves, as well as the grease cups and oil cups made by The Wm. Powell Co.

GARLOCK PACKING CO., represented by H. J. Ramshaw, utilized its space with an exhibit of all varieties of packing including the sheet, round, square, and diagonal forms cut in shapes and sizes to suit every purpose.

MODEL D steam trap in section and the Anderson oil filter were on exhibition by V. D. Anderson & Co. J. H. Meyers was the man who did the explaining and passed out the revised edition of the Anderson data book for engineers.

PALMETTO PACKINGS in round, square and twist forms filled the booth of Greene, Tweed & Co. F. E. Ransley, president of the Central States Exhibitors Association, talked Palmetto to the engineers.

C. F. GREEN represented the Home Rubber Co., whose exhibit consisted of samples of N. B. O. black sheet packing a combination of materials selected to withstand acid, brine, ammonia, steam and hot liquors.

BRASS SPECIALTIES for the steam plant was shown in the Lunkenheimer Co. exhibit in charge of J. Hewetson. Duro blowoff valves, Renewo valves and Ferrenwo valves also made up a portion of the display.

GAS ENGINE EXHIBITS AND CONVENTION

Seen and Held at Milwaukee, June 12 to 14

FOR a baby it certainly was a whopper, but with reasonable growth that may be expected from such a successful beginning, the exhibit will soon strain the capacity of any but the largest convention halls in the country.

And the convention itself was notable for large attendance at the meeting, instructive and helpful papers of interest in what the speakers had to say. It was a serious convention with no room or inclination for playing during the working hours. The show opened on Monday morning and had good attendance from then until the close on Friday evening, and anyone interested in the generation or utilization of power could always find something of interest to study. On Tuesday there was no general meeting of the association but there was a special session of gas engine builders to consider topics of particular interest to them, such as matters of freight rates, insurance restrictions, oil inspection, a standard form of guarantee for internal combustion engines; the question of industrial education and like matters.

Wednesday morning opened the general convention with a record breaking attendance which practically filled the large hall where it was held.

FIG. 1. THE BADGER GAS ENGINES

Introduced by President O. C. Parker, Mayor Bading, of Milwaukee, most cordially welcomed the convention, to which H. W. Bolens responded, announcing also the provisions made for the entertainment of visitors to the city during the week; the chief feature was the banquet held at the Hotel Pfister on Wednesday evening, and in order to avoid interferring with the exhibit, other entertainment was to be furnished for parties as they might desire.

Power in the Field

IN his report for the publicity committee, P. F. Rose brought out a number of interesting facts and emphasized particularly a new thought as to what the use of power for cultivation of land may mean to the human race. He told of the sending out of notices to engine manufacturers and the effort to find out how many gas and other combustion engines are now in use and how many will be needed for the trade of the year. While these figures are confessedly not extremely accurate, something like 600,000 engines are now in use and almost as many more will be needed for the demands of 1912.

Figures from the census bureau estimated that there are now 6,770,000 farms in this country and that 30,000,000 hp. is needed for operating them on the basis of one or more engines for each farm. As to the investment which may well be made for power machinery the figures show that there are something like 24,000,000 horses and mules in use in the North Central States which, at a value of $112.50 per animal, would give an investment of $3,000,000 or $6.25 per acre invested in animal power. The cost of keeping a horse is from $65 to $100 a year, or at an average of $75, would cost $4.38 per acre to feed the horses and mules required for power. The value of products per acre is about $17.53 or about 25 per cent of the product is used up in feeding the animals to give the power for cultivating this land.

If mechanical power was substituted for animal power, it would mean that 25 per cent would be added to the land available for producing food for the human race or food for animals which in turn feed the human race.

FIG. 2. IN THE FIELD BOOTH

As a comparison of the cost of doing work by mechanical and animal power, it was estimated that on the basis of one cent per kilowatt-hour and the use of 10 horsepower hours to plow one acre, the fuel cost for mechanical power would be under 20 cents, while the cost with horse power would be $1.

Mr. Rose estimated that a farm of 200 acres can with economy employ a traction engine to work, this tractor to be of small size and to cost about $2,000. He estimated that the saving by using the tractor on a 200 acre farm would be about $196 a year.

Report of the membership committees by Messrs. Loeb and Perkins showed that 26 manufacturers of engines have been added as a result of the 6 months of the committees' work.

Ability of the Gas Engines

INTRODUCING his paper on this subject, H. W. Jones called attention to the fact that the gas and gasoline engine has ability undreamed of by its first

designers and users. An engine of power plant size can be started up and be carrying its full load in one minute and can continue carrying that load until it wears out. There are upwards of 7,000,000 engines at work in the country today having a capacity of something over 20,000,000 horsepower and the reliability of such an engine is shown by the fact that it can be trusted to carry a vehicle or train 500 miles without stopping, at a speed of 78 miles an hour, a feat as yet not accomplished by any other kind of prime mover. He also stated the fact that there are more gas engines made in Wisconsin in one year than there are steam engines in the entire world; he claimed that with gas at $1 a thousand, the gas engine can furnish power better and cheaper than any other prime mover.

Speaking of lubrication problems, A. E. Potter described the importance of lubricating at all points. He stated that too much oil is as bad as too little, for the surplus is likely not to burn up clean and causes gumming and sticking of the valves. The Stationary horizontal 4-cycle type of engine is easy to lubricate by either wiping or splash system, but the vertical engine piston is of a closer fit, therefore the cylinder has a tendency to wipe the oil off the piston, particularly if it overruns.

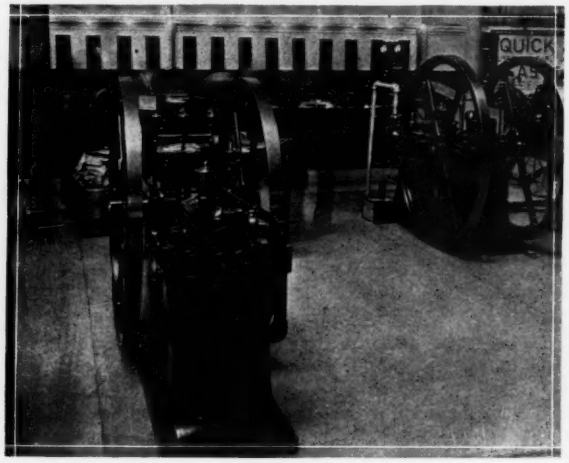


FIG. 3. CHAS. WHITE ENGINE CO.

He advocated either a piston ring or grooves at the bottom of the piston to form a seal at this point and hold the oil on the lower end of the piston. He did not favor splash lubrication particularly on an overrunning system, as he thought that it would carry dust into the cylinder, nor did he favor a forced circulating system where the oil is simply strained and returned into the bearings, as it also may carry dust into the boxes and the parts. He believed that a forced lubrication with clean oil is the best form.

He stated that an oil of high fire test may cause miss-firing. The oil should be burned up clean and a fire test which is too high may work against such a result. He favored a high fire test oil for force feed with clean oil the lower fire test in the splash system or if a circulating system be used.

Speaking of the cold test, he stated that paraffine and stearic material may be used to raise the cold viscosity, but these are bad as they have no lubricating value and artificial viscosity is deceptive.

He advocates that oil should be adapted to the engine and that it should be bought in sealed packages from responsible dealers, and in this way uniform results can be secured.

In the course of discussion of this paper by others, it was brought out that many dealers in smaller engines are already specifying what brands and grades of oil should be used with these engines, but the larger engine builders have not been doing this. Mr. Edward N. Tracey, former oil inspector for Wisconsin, was of the opinion that there is no good reason for

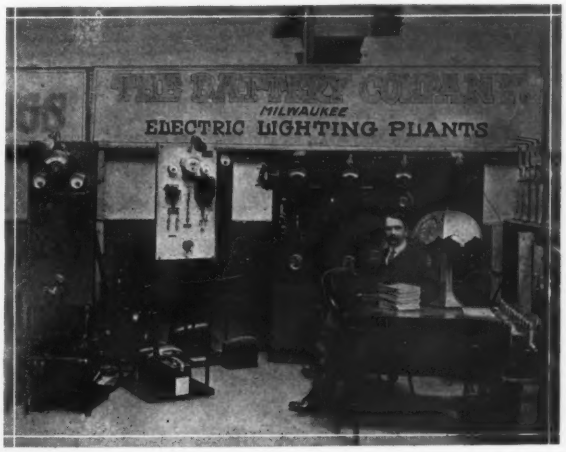


FIG. 4. THE BATTERY CO.'S PLANT

an oil inspection under present conditions. Big users of oil can test their oils and the adaptability for certain purposes better than the inspector can, and small users will get the same kind of oil anyhow, whether it is inspected or not.

Attention was called to the fact that when the laws for oil inspection were past in the various states,

FIG. 5. THE GILSON "SIXTY"

kerosene was the main product and gasoline a by-product, hence the tendency was to get as much of the gasoline as possible into the kerosenes, which might give them a low flash point. Now the condition is reversed, the gasoline is the main product and kerosene a by-product, so that the tendency is to put all the oil possible into the gasoline and there is not likelihood of finding a low flash point in the kerosene.

Mr. Potter stated that the Eastern states have laws again kerosene under 150 deg. flash test, oils of 120

to 150 deg. are cheaper but are considered dangerous. The convention finally went on record with a resolution that oil laws are of no use and are a burden on the users and that oil inspectors should be done away with.

At the banquet on Wednesday evening the hall was filled to over flowing, and after the repast H. W. Bolens, acting as toastmaster, introduced several

FIG. 6. ELECTRIC STORAGE BATTERY CO.

speakers who spoke briefly on the affairs of the association and on the conditions of the industry. Mr. Chas. O. Hamilton, of the National Gas Engine Association Executive Committee, presented to the treasurer, O. M. Knoblock, as it was his birthday, a remembrance in the form of a pair of prism field glasses, for which Mr. Knoblock thanked the givers

FIG. 7. HEER ENGINES

and expressed the hope that he might have the pleasure of seeing them all at his home and letting them use the glasses.

Thursday was devoted to routine business, and use of the gas engine on the farm including papers on The Storage Battery in Isolated Electric Plant by Taliaferro Milton, on Electric Farm Lighting Systems by Otto Borcherdt, on Dirty Spark Plugs and Missed Explosions, on How Can the Dealer Best Increase His Sales, and on The Tractor, by L. W. Ellis.

Friday was devoted to the matter of publicity, and a series of papers on the different methods of obtaining publicity were presented.

Gas Engines and Auxiliaries

THE exhibit of engines may well be classified under 3 heads: tractors and portables, stationary power plant engines and small engines for farm or other use. The auxiliaries include, of course, means of ignition, such as by magnetos and batteries, spark coils, and the miscellaneous devices including the switches, tools, clutches, and means of distributing power, including motors, switchboards, storage batteries and the lights. Of course the biggest engines on the floor were the tractors, because the mountings were in themselves so large. The engines were not of greater power than some of the stationary.

THE CHIEF EXHIBITS of this line were those of the J. I. Case Co., of Racine, Wisconsin, which included a 40-hp. tractor and a 60 hp., both of them running on oil. The 40 hp. stands in the

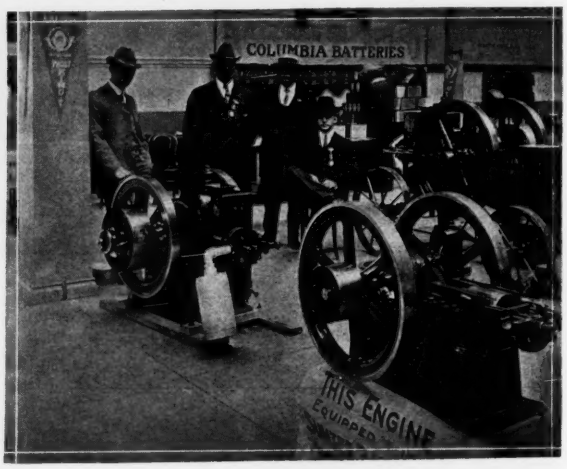


FIG. 8. THE FROST KING ENGINES

foreground of the illustration of the exhibit shown herewith and has cylinders 7¾ in. bore by 8 in. stroke, running at 450 r.p.m., the road speed of the tractor being 2¼ miles for plowing and heavy work, and 3 miles an hour for light road work. The 60 hp. machine is 10-in. bore by 12-in. stroke at 350 r.p.m., giving a rate in horsepower of 60.

AT THE OTHER END of the hall were the Big Four tractors made by the Gas Traction Company of Minneapolis, having 4 cylinders vertical on the shaft and giving a 30 hp. The power plant of the tractor was also shown separate, operated by a motor and sectioned so that the operation of the different parts might be studied.

AMONG THE POWER engines the Wisconsin oil engine was one of the most notable. This engine, made by the Wisconsin Engine Co., of Corliss, had a rating of 65 brake hp. and uses either a kerosene or similar oil in a cold carburetor in the same way that gasoline is used in the carburetor of an automobile engine. Multiplying levers are used for operating the valves the same as on the larger sizes of Adams Wisconsin Gas Engines, giving a noiseless valve gear. An interesting feature of the exhibit was a model of the cylinder head and valve gear operated by motor drive showing the exact method and time in which the valve and sparks perform.

ANOTHER OIL ENGINE shown at the exhibit was that of the Elyria Gas Power Co., of Elyria, Ohio, called the Elyria Oil Engine. This is known as the Semi-Diesel 2 cycle type with maximum compression pressure of 400 lb., the oil is atomized outside the cylinder. The fuel is admitted during the forward stroke and burns as it enters the cylinder, giving a mean effective pressure of 85 lb. It is stated that this engine burns equally well either gasoline or crude oil; it runs in sizes from 25 to 125 hp., starts with compressed air with 150 lb. pressure, and runs at speeds from 240 to 260 r.p.m.

STILL ANOTHER NOTABLE exhibit of oil engines was that of the Falk Co., which showed a 10 hp. running on 450 r.p.m., direct

connected to a 7½ kw. generator and running continuously on 4-cent kerosene oil, lighting a flashing electric sign which is shown in one of the illustrations. In this exhibit there was shown besides the electric lighting outfit, a 3½ hp. stationary engine and a 3½ hp. portable tank cooled and a 5 hp. portable with screen cooling.

AN EXHIBIT HAVING a large number of engines in it was that of The Heer Engine Co., Portsmouth, Ohio, including a 40 hp. portable, a 25 hp. portable, a 25 hp. direct connected to a 15 kw. generator, 10 hp. stationary which ran at 600 r.p.m. mounted on top of a barrel, a 16 hp. portable, and a 15 hp. which was belted to a generator and shown as a complete lighting plant with switchboard. All Heer engines are of double opposed type, giving freedom from vibration and close regulation.

TWO WHITE & MIDDLETON gas engines of 6 and 10 hp. were shown by the Chas. White Gas Engine Co., of Baltimore, Md. These engines were running on city gas and have auxiliary exhaust ports which allow a large part of the burned gas to pass out of the cylinder as the piston starts on the exhaust stroke, thus relieving the main exhaust valve of considerable heat and pressure.

IN THE SPACE of the Field-Brundage Co., of Jackson, Mich., were included a 12 hp. stationary engine, a 12 hp. portable, and a 2 hp. stationary. The excellence of running was shown by a vase of flowers standing on the engine cylinder which showed no vibration even while the engine was at full speed. The engine also has an automatic starter which starts the engine on gas or gasoline.

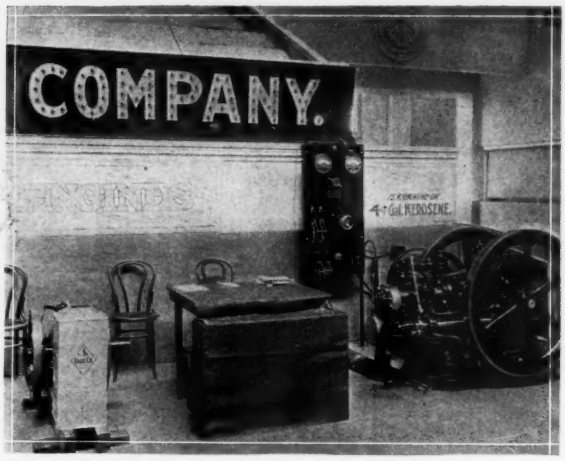


FIG. 9. FALK CO.'S KEROSENE ENGINE PLANT

INTERNATIONAL GAS ENGINE Co., of Cudahy, Wisconsin, showed engines in horizontal and vertical type, both single and multicylinder. The stationary runs in sizes from 6 to 60 hp., and the vertical unit from 50 to 350 hp.

DEAN GASOLINE ENGINES and Dean gas engines were exhibited by the Dean Mfg. Co., of Milwaukee, the gasoline engines being from 4 to 6 hp. and the gas engines from 9 to 35 hp.

AMONG THE SMALLER engines shown, one of the most interesting exhibits was that of the Gilson Mfg. Co., of Port Washington, Wisconsin, which showed a plant in operation, called the Farmer's Power House on Wheels as seen in the foreground of the illustration of the exhibit. This is made in sizes from 1¾ to 6 hp. and arranged for belting to any kind of machinery or for operating a pump jack when desired.

J. THOMPSON & Sons Mfg. Co., Beloit, Wisconsin, exhibited its air cooled and hopper cooled gasoline engines, running in sizes from 2 to 8 hp.

BADGER ENGINES nicknamed the Farmer's Friend were shown by the Christensen Engineering Co., of Milwaukee, in a number of sizes. The stationary sizes run from 4 to 30 hp., heavy iron subbase and are made in either tank or hopper cooled designs.

LAUSON ENGINES, made by the John Lauson Mfg. Co., New Holstein, Wisconsin, run from 1½ to 28 hp. in either portable, semi-portable or stationary designs. The engines are known as the Lauson Frost King and are finished with magneto mounted on the engine as part of the regular equipment.

AMONG ENGINES for portable purposes those made by the Gile Boat & Engine Co., of Ludington, Mich., were attractively displayed arranged for fruit spraying, or marine work and for general power purposes. The portable type is air cooled in the smaller sizes.

A COMPACT LITTLE outfit was the Phillips Governed Opposed Marine Motor shown by L. C. Kuhnert Jr. Co., of Chicago, which put a motor capable of developing a 10 hp. into a space 29 by 18 by 19 in.

STA-RITE ENGINES for portable use, watering plants, and general purposes, were shown by the Sta-Rite Engine Co., of La-Crosse, Wisc. Those in the exhibit ran from 1½ to 16 hp., mounted on skids with the weight low down to avoid top heaviness.

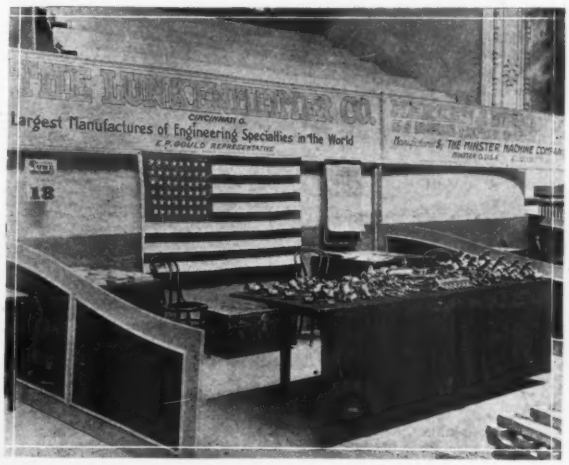


FIG. 10. THE LUNKENHEIMER CO.

STOP BUYING FLYWHEELS was the plea of the Phillips Gasoline Engine & Motor Co., of Chicago, Illinois, in calling attention to its 7 in 1 engine which has 2 cylinder opposed to each other, either cylinder being usable alone.

FROST ENGINE Co., of Evansville, Wisconsin, showed a Hustler 1 hp. water cooled engine and illustrated also a complete lighting plant for all installations.

BLOOMER GASOLINE ENGINES, hopper cooled, from 1 to 6 hp., were exhibited by the Bloomer Machine Works, of Bloomer, Wisconsin.

THE WISCONSIN PORTABLE and Semi-Portable, from 1½ to 4 hp. and in the stationary lines from 1½ to 20 hp., were exhibited by the Lauson-Lawton Co., of DePere, Wisconsin.

FIG. 11. GILE ENGINE APPLICATIONS

"ENGINES OF real merit—for those who care," was title given to its exhibit by the Holbrook-Armstrong Iron Co., of Milwaukee. These ran in sizes of 1½ and 2½ hp., mounted on skids for going immediately to work or for easily being transported.

WISCONSIN MACHINERY & Mfg. Co., of Milwaukee, exhibited its multiple cylinder engines, particularly for marine work, running in sizes from 5 to 60 hp. It is known as the Wisconsin valveless motor, guaranteed against back fire.

GASOLINE ENGINES and governor pulleys were shown by the Brownwall Engine & Pulley Co., of Lansing, Mich. These engines are made from 1 up to 6 hp., air cooled and with a fan for insuring a strong circulation of air across the cylinder.

TURNER MFG. CO., of Port Washington, Wisconsin, exhibited its hopper cooled engine in sizes from 2 to 7 hp. These are slow speed, long stroke and with long connecting rods, and are known by trade name of Simplicity.

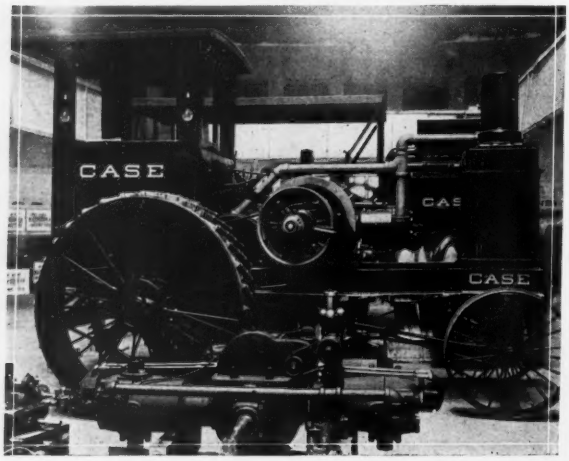


FIG. 12. THE CASE TRACTORS

DAVIS MFG. CO., of Milwaukee, showed a 2-cylinder horizontal opposed motor and a 4-cylinder 6½ by 6-in. vertical. Also detail parts and methods of construction were included in the exhibit.

AN INTERESTING plant was that of The Battery Co., showing a complete electric lighting plant with storage batteries on the 30-volt system. This included engine, generator, battery, switchboard, and instruments as shown in view of the exhibit herewith.

THE FLICKINGER IRON WORKS exhibited a 2½ hp. air compressor and gas engine contained in the same cylinder and operating off city gas compressing air at 160 lb. pressure into a tank; also a 6 hp., hopper cooled, stationary type engine for belting to generator or air compressor.

FIG. 13. ACHESON GRAPHITE LUBRICANTS

Special Devices

OILDAG AND Gredag, for use on the engine because it saves oil, reduces carbon and smoke and gives increased power through increased compression were shown by the International Acheson Graphite Co., of Niagara Falls, N. Y., the display including not only samples of different lubricants, but a model of the electric furnace in which the artificial graphite is manufactured.

SUPERIOR DROP forgings and special tools for engineers, made by J. H. Williams & Co., of Brooklyn, N. Y., made an attractive exhibit. Gas engine drop forgings were a prominent feature, also the line of crank shafts, valves and repairs suitable for all engine work.

VALVELESS FORCE and sight feed oil pumps as made by the Madison-Kipp Lubricator Co., of Madison, Wisc., were arranged in an interesting and instructive display.

ERIE FORGE CO., of Erie, Pa., showed what it can do by means of a shaft doubled on itself and connecting rods twisted into an S shaped loop. The company makes both carbon steel and the coke Canadian steel forgings, giving special attention to having the forgings of the highest quality. This display as well as that of the Chicago Drop Forge and Foundry Co., was handled by the Williams & Wolf Co., Milwaukee. A feature of the Chicago Drop Forge and Foundry Co.'s devices was the C. D. F. patented adjustable bearings for connecting rods, and the crank shaft consisting of only 5 parts and no shims used.

FOR GAS ENGINE MANUFACTURERS the Recine high speed metal cutting machine shown by the Recine Tool & Machine Co., of Recine Junction, Wisc., was an interesting and labor saving tool.

STAR BRAND TRIPLE Braid Weather Proof Wire shown by the American Electrical Works, of Phillipsdale, R. I., was exhibited as being good for ignition circuit or for lighting circuit.

BY MEANS of a National Automatic Expansion valve, the National Regulator Co., of Chicago, Ill., was able to maintain constant temperature of the out-going water of the cooling system regardless of the incoming temperature of the water or the load on the engine. This is an advantage, as it keeps the cylinder at the desired temperature at all times and thus avoids waste and is the best running condition for good economy.

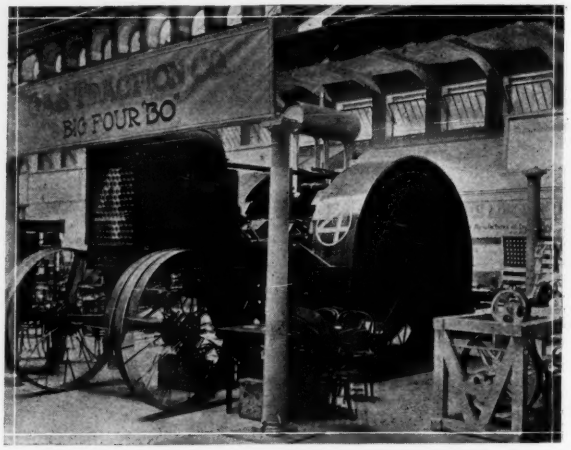


FIG. 14. THE BIG 4 TRACTOR

THE MINSTER MACHINE CO., of Minster, Ohio, exhibited the Herken, Herken Jr., and Minster friction clutches, pulleys and cutoff couplings used in connecting gas and gasoline engines to the driven machinery.

BROWN FRICTION CLUTCHES and couplings, made by the Brown Clutch Co., of Sandusky, Ohio, for use in connecting engines to generators or in connecting line shaftings, were demonstrated by operating models.

W. A. JONES Foundry & Machine Co., of Chicago, exhibited its line of friction clutches, pulleys and other transmission apparatus.

OBENBERGER DROP FORGE CO. showed its full line of shafts, gears, rods and special shapes, rough and finished, from chrome Canadian or from chrome nickle steel or from carbon steel.

AN EXHIBIT of engineers' and machinists' tools and supplies was made by the Phillips Groos Hardware Co., of Milwaukee, including the J. H. Williams wrenches and special tools, Magnolia metal, Dixon graphite lubricant, and the like.

Carburetors

THE SCHEBLER in models, D, E, H and L, as made by Wheeler & Schebler, of Indianapolis, Ind., made up a complete line in the exhibit of that firm.

THE LAVIGNE improved generator valves, as made by the Lavigne Mfg. Co., of Detroit, were shown in complete devices sectional models, both horizontal and vertical patterns. Other products of the company were the Lavigne Hose Couplings, Lavigne Lubricator, mechanical oilers, sight feed oilers and Lavigne solderless fittings.

PLANHARD MFG. CO., of Kokomo, Ind., exhibited the Planhard carburetor, which is claimed to give a perfect mixture at all speeds and under all weather conditions.

THE LUNKENHEIMER CO., of Cincinnati, Ohio, showed a numerous line of gas engine specialties including generator valves for gasoline engines, lubricating devices of all sorts, motor boat whistles, and general brass fittings.

THE PENBERTHY INJECTOR CO., of Detroit, Mich., had a line of grease and oil cups and other brass goods which are particularly well adapted to the gas and gasoline engine plant.

Ignition Devices

QUICK ACTION igniting dynamos, magneto generators, battery connections, switches and primary coils, were shown by the Knoblock-Heidman Mfg. Co., of South Bend, Indiana, the quick action switches made an attractive background.

THE MOTSINGER AUTO Sparker was shown by the Motsinger Device Mfg. Co., of LaFayette, Indiana, also the d.c. magneto, operating lights direct from the magneto without the use of batteries.

WIZZARD TUBULAR magnetos and Star ignition magnetos which are similar to the Wizard but heavier were exhibited by the Hercules Electric Co., of Indianapolis, Ind.

HENRICKS IMPROVED magnetos, including the Comet, the Eureka and the Unisparker were exhibited by the Henricks Novelty Co., of Indianapolis, Ind.

NEW YORK COIL CO., of Pearl St., New York, had a display of the Rhoades' unit spark system including spark coils, switches, etc., and the Rhoades' distributor and timer.

WICO IGNITER, Type O for heavy engines and type C for smaller engines was shown by the Witherbee Igniter Co., of Springfield, Mass. It is claimed for this that it has no batteries, no coils, no timer, no brushes or moving contracts and that the spark is independent of the speed.

THE DELCO IGNITION system including magneto or generator, battery, automatic cutout, ignition circuit, and light was shown by the Dayton Engineering Laboratories Company of Dayton, Ohio.

THE SPARKS that count was the slogan of the Lemke Electric Co., of Milwaukee, exhibiting its Lemke vibrator, coils, battery connector, porcelain spark plugs, single and double throw switches, and cable terminals.

ENDURO SPARK COILS were exhibited by the American Electrical Works of Phillipsdale, R. I., in various types for use in make and break ignition systems.

PFANSTIEHL COILS and magnetos, the product of the Pfanstiehl Electrical Laboratory, of North Chicago, Ill., had an interesting exhibit and included the Junior magneto, the make and break, and various other styles of coils.

"POINTERS ON SPARK PLUGS" was given by the Champion Ignition Co., of Flint, Mich., describing its "AC Star" design.

M. M. M. M. Co., incorporated, of Marshalltown, Iowa, demonstrated its V-Ray and its M. M. M. M. spark plugs which are guaranteed for life.

PRACTICAL POINTERS about spark coil adjustment were given by the Nungenser Carbon and Battery in connection with its exhibit of Acme Rapid Fire Dry Batteries.

COLUMBIA DRY CELLS and the Columbia Multipole battery for motor ignition and lighting were shown by the National Carbon Co., of Cleveland, Ohio.

THE SUMTER 3-M Magneto, "the heart of the engine," was shown and fully explained by the Sumter Telephone Mfg. Co., of Sumter, South Carolina, these magnetos being in 2 types, one for variable ignition and the other for stationary ignition. The variable time device is so arranged that it swings about the axis of the magneto to give early or late ignition.

IN THE EXHIBIT of the Electric Storage Battery Co., of Philadelphia, there were shown a number of different types of battery plates, of battery cells and a complete line of the company's literature on the use of storage batteries for ignition power service and railway service and especially for isolated low voltage plants or for isolated 110-volt plants.

THE BOSTON WOVEN HOSE and Rubber Company have just appropriated $415,000 for the erection and equipment of a new power house at their works in Cambridge, Mass. The business of the company has entirely outgrown the present facilities for power supply, though through the efforts of their chief engineer, John C. Long, it has been possible by makeshift and scattered units to keep the wheels going round. The new power house, for which ground will be broken July 15, will be equipped with 4 600 hp. boilers, one 600 and 2 200-kw. high-pressure turbines, and all apparatus incidental to complete operation of a first class modern plant.

YOUR WORK AND MINE

BY THE "JOURNEYMAN ENGINEER"

IT'S my job to visit with you. Some day soon you may find me dropping in on you without warning. I like to talk about you and for you. Your troubles interest me. I'm paid to talk about you, not about myself. When I come back here to the office I must give out all you have told me. Your troubles of yesterday, and to-day, and your worries about tomorrow. That's the way editors know what you, the readers want. That's what your dollar buys—"Service"—and you surely get it from Practical Engineer.

From Down Indiana Way

The engineers down in Indiana are all coming along nicely—working hard and getting results. They want more in Practical Engineer about Turbines. The June 1st issue contained the first of a series on Turbine Practice—don't miss them.

"Sandy MacDougal" Will Write Again

The old guard and the younger generation are all taking great interest in Father MacDougal's Letters. "Sandy" has a way all his own and promises faithfully to be heard from again. He's thinking about turning out an entirely new character.

W. A. S. Charles L. Hubbard has been writing articles for Practical Engineer on Power Plant Design for 2 years. They will continue.

They Will Be Published in Book Form

The articles entitled Practical Lessons in Electricity will be continued throughout the season and afterwards published in book form. Don't miss these articles.

INTRODUCING PRACTICAL ENGINEER CONTRIBUTORS

Career of Calvin F. Swingle

As an inspiration to men who now hold humble positions, but who are ambitious to rise in the world, the career of Calvin F. Swingle, who has fought his way from day laborer to the front rank of literary men, is interesting.

Mr. Swingle's opportunities for obtaining an education in his younger days were limited, he having to leave school at the age of 12 years, and go to work as the sole support of his widowed mother and her family of small children. Being of a mechanical turn of mind, he naturally sought work around machinery, and at the age of 17, when he enlisted in the army he was in charge of a small steam plant.

Returning home at the close of the war he again resumed his chosen occupation of engineer. He came to Pullman, Ill., in 1880, and was in the employ of the Pullman Company as an engineer during a period of fourteen years, the last seven years of which he was chief engineer.

Leaving the service of the Pullman Company he took charge as chief engineer of the car works at Hegewisch, Ill., and remained there five years, when he entered the Chicago city service, being appointed by the Civil Service Commission as inspector for the board of examining engineers. The first edition of Swingle's hand book was published in 1903, under the title of The Twentieth Century Hand Book for Steam Engineers and Electricians, three later editions have been published.

In addition to his books for stationary engineers, Mr. Swingle is also the author of several other text-books, which, like all of his other works, are written from the practical engineer's standpoint.

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

A NEW METHOD OF MEASURING STEAM CONSUMPTION

STEAM consumption of a turbo generator has been reduced to as low as 12 lb. per kw.-hr. This high economy is secured by careful operation and by refinements in efficiency of auxiliary apparatus. But if the operating force has no guide in maintaining high efficiency, a fall in pressure, superheat or vacuum, a badly adjusted load, or wear of turbine blades, may cause loss of economy which is far more serious than is realized.

The steam consumed by a turbine or engine can be determined with accuracy by weighing the "steam water" or condensate from a surface condenser. A simple, and direct method is presented in the Indicating Hot Well, which is similar in size and appearance to the ordinary hot well and is attached directly to the bottom of the condenser, forming a part of the shell. This adds another valuable function to the equipment, which has for its purpose besides maintaining high vacuum, that of providing pure distilled water for boiler feed, of heating this water to the highest feed temperature, and now the measurement of the amount of condensate and the rate of steam consumption of the engine or turbine.

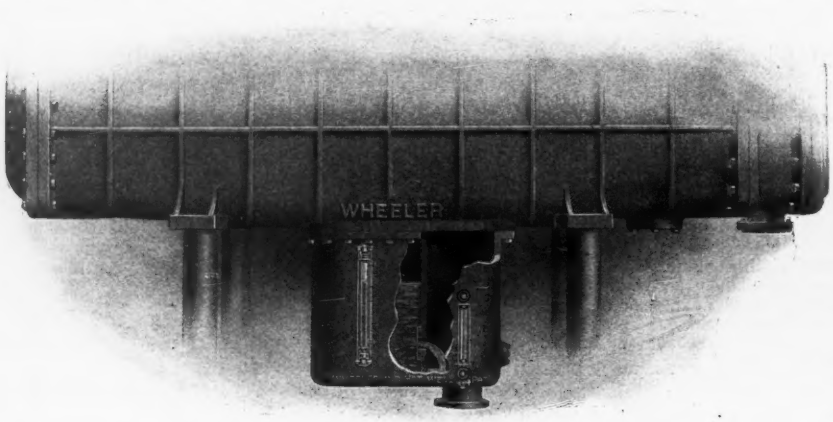


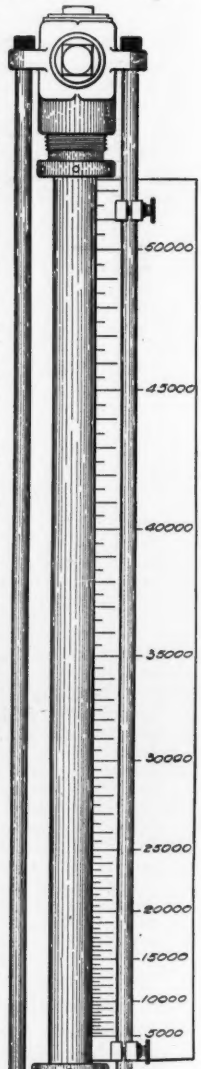
FIG. 1. SURFACE CONDENSER, SHOWING INDICATING HOT-WELL ATTACHED DIRECTLY TO CONDENSER SHELL

The Indicating Hot Well is attached directly beneath the condenser, as shown in Fig. 1. The opening in the bottom of the condenser is built so that the condensate drains into the left-hand chamber of the hot well, and communication from this chamber to the hot well pump suction is secured through an orifice in the dividing wall.

The velocity of discharge through an orifice of given diameter, varies directly as the square root of the head, and the quantity of water discharged is equal to the product of this velocity, the area of the orifice and the coefficient of contraction. With a properly designed orifice this coefficient remains almost exactly constant for widely different values of the head upon the orifice, therefore the quantity of discharge is obtained with accuracy by a carefully calibrated indicating gage glass, reading the head.

As may be seen from the illustrations, the orifice is formed in a brass plate inserted in the partition wall. It is polished and finished to insure accuracy of flow. Special fittings are used to attach the indicating gage to the shell of the hot well, with ball check valves in each fitting so that should the gage glass break, the inflow of air will be prevented and the gage glass can be replaced at leisure. A gage glass is also provided to show the height of the water in the hot well suction compartment, where the water must not be allowed to submerge the orifice.

The scale attached to the indicating gage reads direct in pounds of steam per hr., as shown in the drawing. Each orifice is made independently, carefully calibrated, and a special scale, etched upon steel, furnished for it. Over the whole range of readings the accuracy is within 2 per cent, and for readings from 75 to 125 per cent load, the accuracy is within 1 per cent.



INDICATING GAGE GLASS FOR HOT WELL

The Wheeler Indicating Hot Well is a practical and simple solution of the problem of measuring steam consumption. The indicating gage reads pounds of steam per hr., the station wattmeter gives load in kilowatts, and the rate of steam consumption in pounds per kilowatt-hour is obtained by simple division. This figure en-

tered regularly upon the engineer's log sheet, and charted from day to day, is of great importance in maintaining high plant economy.

The device is made by the Wheeler Condenser & Engineering Co.

THE HULSON GRATE

THIS grate has some new features which are well shown in the illustrations herewith. Fig. 1 represents the parts of the grate, 9 being the side bar which acts as a carrier for the finger bars which bar is shown in position at the side of the perspective view Fig. 2. No. 6 is the finger bar with round ends which slip in the pockets of the side bar. Projecting downward from this finger bar is a lever which serves to rock the bar and on top are placed the fingers (3) which have a notch in one side of the groove fitting over a rib on the finger bar. This rib is cut away on one end to allow the fingers to be slipped on at that end and pushed along on the bar until in position. Fingers are thus slipped on and moved along until the bar is filled, the last finger being placed partly on the key.

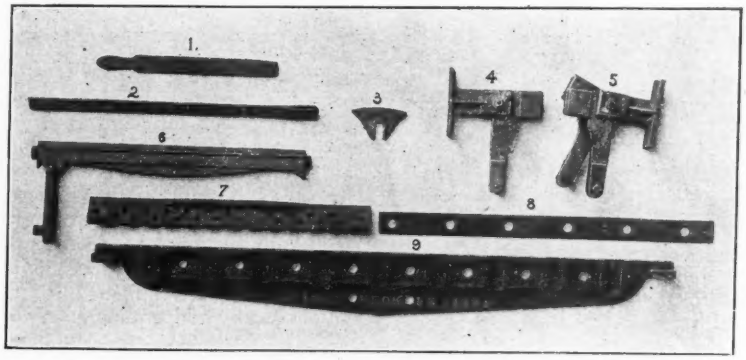


FIG. 1. PARTS OF THE GRATE TAKEN DOWN

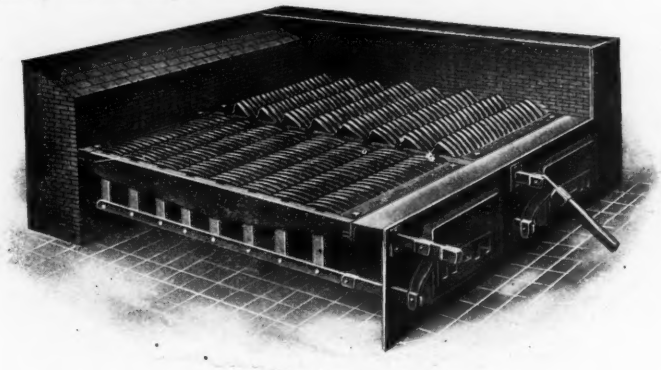


FIG. 2. PERSPECTIVE VIEW OF THE GRATE ASSEMBLED

Air space through the grate is determined by the thickness of the shoulders on the fingers, hence to change the air space all that is necessary is to change the fingers without changing the carriers or the finger bars.

7 is the tie bar which goes across the front and back to hold the side bars together. Bars have cone-shaped openings for ventilation and have a heavy rib underneath to prevent warping. The reach bar (8) is connected to the bottoms of the arms on the finger bars as shown in Fig. 2 and by means of the link is also connected through the shaker brackets at the front of the bar. This shaker bracket is operated by means of a lever giving the bars a rocking motion which clears the fine ashes and on occasion can be moved so far as to drop everything through. The journals are located far enough below the grate surface so that the motion of that surface is principally horizontal.

With this construction of grate it is possible to get, with ⅜-in. openings between the fingers, 55 per cent of the space as air passage and with ½-in. openings 75 per cent as air space. This gives a clean grate and with moderate draft coal burns to fine ashes and these ashes come through the grate with light shaking and without breaking up the fire bed. These grates are made to the measurement of the present furnaces on any boiler, no change being necessary, the only condition being the length of the grate must be a multiple of 7 inches, the grate resting on the bridge at the back. The grates are usually made 2 sections wide and may have the shaker brackets placed on either side or in the center of the front and still leave ample clearance in the ash pit. It has been in use for several years at all kinds of work from waterworks and central stations to laundries and from refrigerating and cold storage plants to government steamboats and has procured many re-orders. It is made by the Hulson Grate Co., of Keokuk, Iowa.

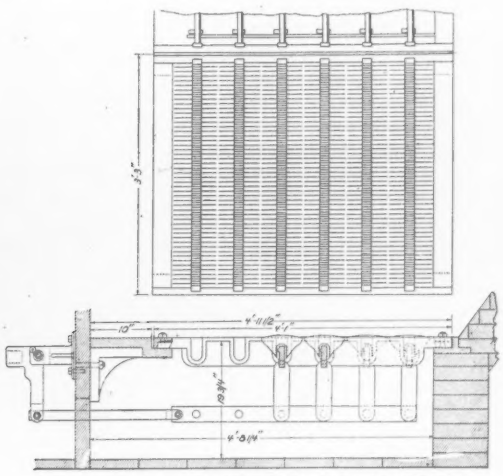


FIG. 3. PLAN AND SECTIONAL ELEVATION OF ASSEMBLED GRATE

POWERS SYSTEM OF REGULATION

THE Powers Regulator Co., makers of the Powers Systems of Regulation claims special attention to its thermostat on the ground that it is unique, and does not depend upon molecular expansion in its thermostatic or sensitive member. It employs a hollow, expansible metallic disk charged with

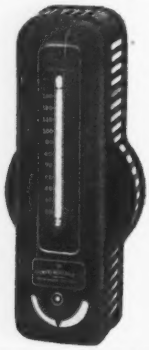


FIG. 1. POWERS THERMOSTAT COMPLETE WITH COVER

FIG. 2. POWERS THERMOSTAT WITHOUT COVER

a volatile fluid whose boiling point is somewhat below the operating temperature of the instrument, and which develops a pressure which varies with the temperature to which it is exposed.

this is important because of the relative reduction in the amount of moisture, fine dust and oil that the compressed air will carry into the piping system and ultimately to the thermostats.

Figure 1 shows the Powers thermostat complete with its protecting cover; Fig. 2 without cover.

The Powers people claim for their thermostat a graduated action which is of great value when applied to the operation of mixing dampers in plenum systems or feed valves on radiators used with either hot water or 2-pipe steam vacuum systems. By the proper graduated control of these valves the exact amount of heating medium necessary to the weather conditions is admitted, with the result that fluctuations in the room temperatures entirely disappear.

Figure 3 illustrates what may be termed a typical application of the Powers System of Heat Regulation to a fan plenum system of standard type. Tempering coils are under automatic control by means of valves C and bypass damper L, these being actuated by tempered air thermostat E. Reheating coils may be controlled by valves N actuated by a thermostat exposed to outdoor temperature and operating to turn these coils on, section by section, as the weather grows colder. Mixing dampers G take care of the individual room control, each room having its equipment of these dampers operated automatically and gradually by thermostat F.

With a system of this kind there is little left for the

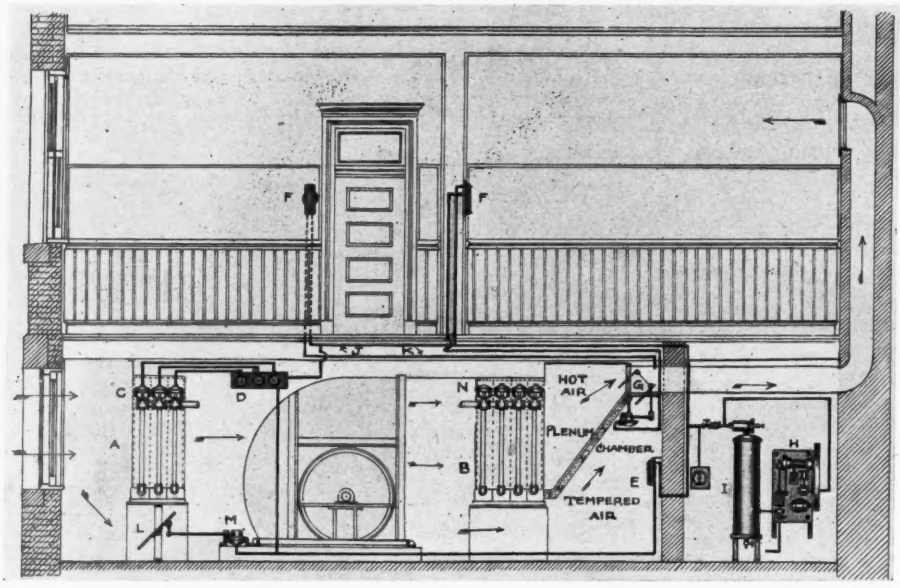


FIG. 3. TYPICAL APPLICATION OF POWERS SYSTEM OF HEAT REGULATION

The company claims for a thermostat constructed on this principle absolute permanency of adjustment and a great figure of efficiency. The thermostatic disk is sufficiently powerful to actuate directly the valves which control both the supply and exhaust of the compressed air which is used as a motive power for the actual operation of the valves and dampers controlling the heating medium.

This double valve thermostat construction reduces by about 80 per cent the amount of air otherwise needed for the operation of a system of temperature control, and janitor to do except attend to his fires, the operation of his heating plant being automatic in reality.

CORRECTION NOTE

IN our issue of June 15 a notice was given in regard to the booklet "Smokeless Chimneys, How to Comply with Smoke Ordiance." By some error in the composing room this was credited to the France Gas Consumer Co., of Matteawan, N. Y., and should have been to the Furnace Gas Consumer Co.

CATALOG NOTES

AIR DRIVEN boiler tube cleaners are described in Bulletin U, a pamphlet received from the Lagonda Mfg. Co., Springfield, Ohio. The cleaner is of novel design, having an arrangement of ports and passages by which the different paddles will receive ample air pressure, while those that are not in operation are so cut off from the air supply that leakage is practically eliminated. The scheme for substituting different sized ports to meet varying scale, or air, or steam pressure conditions, also tends to greater economy.

FROM THE INDUSTRIAL INSTRUMENT CO., of Foxboro, Mass., comes Bulletin No. 62, illustrating the Dr. Horn stationary tachometers and tachographs, for which the company is sole distributor in the United States. These instruments are for indicating and recording the speeds of shafting or pulleys and are of different types for hand or belted use and for the measuring of ordinary speeds and also for recording minute variations in speeds of machinery. Copies of bulletin may be obtained by addressing the company at Foxboro, Mass., and mentioning Practical Engineer.

SUBSTITUTION OF METAL for work in building operations is rapidly taking place, both on account of the increasing cost of lumber and because of the advantage of fireproof construction. A text book on metal lumber as a substitute for wood is issued by the Berger Mfg. Co., of Canton, O., who will be glad to send copies on request.

CONFESSIONS OF AN ENGINEER, and Conserving the Heat Unit are 2 interesting bulletins issued by the American District Steam Co., of North Tonawanda, N. Y., and treating of the turning of exhaust steam into cash revenue.

JUST FROM THE PRESS is a book of 654 pages, the 1912 catalog of the Lunkenheimer Co. A large number of new goods is described, the catalog containing some 100 pages more than the previous issue. It forms one of the largest lines of high grade engineering specialties in the world and the book contains besides this complete catalog a large quantity of useful information and data which engineers will find of great value.

THE MONARCH VALVE AND Mfg. Co., Warren, Mass., has issued a second edition of its complete catalog listing an extensive line of valves for all purposes.

BALL BEARINGS IN WOOD-WORKING Machinery is the title of an attractive bulletin recently issued by the Hess-Bright Mfg. Co., Philadelphia, Pa. As the name implies it describes this company's well known product used in woodworking establishments.

WAGNER ELECTRIC MFG. CO., St. Louis, Mo., has issued Bulletin 94 in miniature. It describes "Unity Power Factor," single-phase motors.

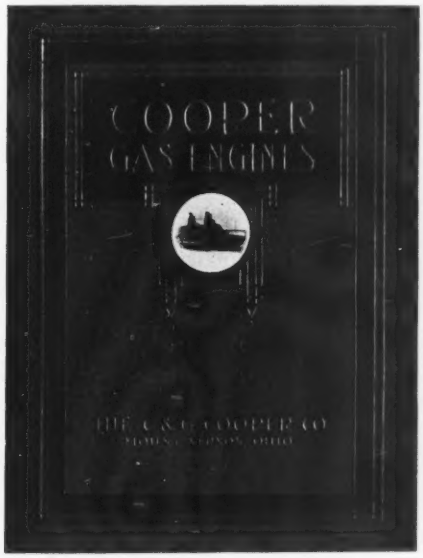
BULLETIN No. 182 has been received from Roth Brothers & Co., Chicago, It describes and illustrates a complete line of motors and generators manufactured by this company and shows a number of interesting applications.

INGERSOLL-RAND COMPANY, 11 Broadway, New York City, has recently issued Bulletin Form No. 7004, describing Cameron Steam Pumps in various types and sizes.

FROM THE BRISTOL CO., Waterbury, Conn., we have received catalog No. 1000 of 64 pages illustrating and describing its recording gages for pressure and vacuum. Of special interest among the contents are several reproductions of continuous chart records of draft in stack of boiler, gas pressures in gas mains, high and low pressure on steam boilers, vacuum from condensing engines. The accuracy of these charts is assured by the fact that the recording pen arms of the gages are attached directly to the pressure tubes without the use of multiplying devices.

THE RECENT ISSUE of the "General Electric Review" published by the General Electric Co., takes up in detail the latest developments in industrial control. Articles on electrical control apparatus for mines, battle ships, newspaper presses and various other industrial uses cover the subject fully, with the aid of excellent illustrations.

COOPER GAS ENGINES are built for heavy work and large power in horizontal, double-acting, 4-cycle, single and twin tandem types. They are hand-



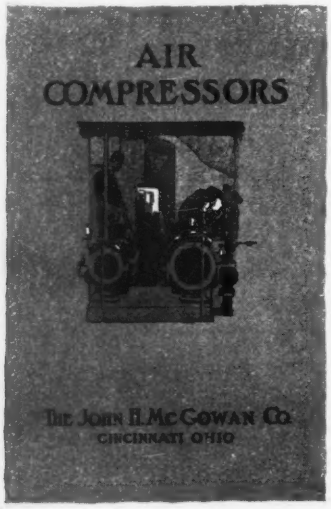
somely illustrated and fully described in an attractive catalog which is as informing as it is attractive. Copies may be secured by writing to the C. & G. Cooper Co., P. E., Mt. Vernon, Ohio.

THE HORIZONTAL DUPLEX PISTON PUMP, made by the Deane Steam Pump Co., 115 Broadway, New York, and operated by direct connected vertical gasoline engines are described in Bulletin D 171 issued by the Deane Steam Pump Co. These units are built in sizes with a capacity of from 23 to 52 gal. per minute, and the full description may be had by writing for the above bulletin.

THE GENERAL ELECTRIC COMPANY recently issued an attractive bulletin, No. 4938, devoted to its Type H transformers. This bulletin supersedes the previous bulletin on the same subject.

BULLETIN No. 4949, just issued by the General Electric Company, is devoted to Direct Current Portable Instruments, Type DP-2, which are designed for laboratory and general testing purposes. This line of instruments includes ammeters, voltmeters, miliammeters and milli-voltmeters. The publication supersedes the Company's previous one on this subject.

AIR COMPRESSORS is the title of the first of a series of 8 catalogs which is now being distributed by The John H. McGowan Co., of Cincinnati. This catalog illustrates and describes the complete line air compressors and receivers made by the company, also gives complete rules for their installation and



operation. Succeeding catalogs will each deal with a special type of pumping apparatus. Those who secure the first of the series, the front cover of which is illustrated herewith, will want the other numbers to complete the set.

DEPARTMENT OF THE INTERIOR, Bureau of Mines, has for distribution the following new publications: Bulletin 36, Alaskan coal problems, by W. L. Fisher, 1912, 32 pp., 1 pl.; Technical Paper 12, the behavior of nitroglycerin when heated, by W. O. Snelling, 1912, 14 pp., 1 pl.; Technical Paper 13, gas analysis as an aid in fighting mine fires, by G. A. Burrell, 1912, 16 pp.; Technical Paper 16, the deterioration and spontaneous combustion of coal in storage, by H. C. Porter and F. K. Ovitz, 1912, 14 pp.; Miners' Circular 6, permissible explosives tested prior to January 1st, 1912, and precautions to be observed in their use, by Clarence Hall 1912, 20 pp.; Reprint of Bulletin 37, comparative tests of run-of-mine and briquetted coal on locomotives, including torpedo-boat tests and some foreign specifications for briquetted fuel, by W. F. M. Goss; reprint of United States Geological Survey Bulletin 363, 58 pp., 4 pls. The Bureau of Mines has copies of these publications for free distribution. In asking for publications order them by number and title.

"CONCRETING IN WINTER" is the title of an interesting booklet recently issued by the Aberthaw Construction Co., 8 Beacon St., Boston, Mass. It embodies some of their experience in cold weather reinforced concrete work, extending over a period of 18 yr. The booklet is well illustrated and besides giving a description of the methods used by the Aberthaw Construction Company it points out why reinforced concrete should be selected for winter work in preference to other types of construction. To engineers and all who have anything to do with reinforced concrete it will be found interesting, as it shows just what can be done in the winter by experienced concrete contractors. It will be sent free on request to the Aberthaw Construction Co., Boston, Mass.

PITTS & KITTS MFG. & SUPPLY CO., of 39 Cortlandt St., New York, is preparing a new general catalog of its specialties which will be ready for distribution shortly and will be sent on application to all engineers giving their firms and positions and mentioning Practical Engineer.

THE WM. POWELL CO., Cincinnati, O., has sent us Catalog No. 10, listing a large line of Dependable engineering specialties.

TRADE NOTES

DURING THE MONTH OF MAY the Sims Company, in addition to making its average number of less carload shipments, forwarded several carloads of heaters, distributed as follows:

Three Heaters for the State Asylum at Pendleton, Ore.; 2 Heaters for the Allen Fire Dept. Supply Co., Howard, R. I.; 3 Heaters for the new Filene Bldg., Boston, Mass.; 8 Heaters for the new State Insane Asylum, Lima, Ohio (5 carloads).

The last mentioned shipment is of more than passing interest by reason of the unusual size of heater furnished. The Asylum is built on the cottage plan, several buildings being grouped about a central court, the entire plant covering several acres. The power plant is equipped with boilers having a total of 2000 hp. capacity; to serve this battery of boilers, the Sims Company has furnished two vertical cast iron open type feed water heaters, each weighing approximately 12,000 lb. The main shells for these heaters, measuring 64 in. in diameter and 100 in. high, were cast in one piece, a fine piece of loom mould work produced by the Erie Engine Works Foundry.

AMONG RECENT SALES of the York Manufacturing Co. the following are noted: Young Men's Christian Association, Erie, Pa., 1 2-ton refrigerating plant; Trojan Ice Cream Company, Cohoes, N. Y., 1 17-ton refrigerating plant; The Kent Company, Ltd., Montreal, Canada, 1 4-ton refrigerating plant to be installed for Paul Gariepy, Montreal, Canada; Desbrick & Company, Brooklyn, N. Y., 1 175-ton compression side, and 75-ton ice making plant; The Kent Company, Ltd., Montreal, Canada, 1 17-ton refrigerating plant, to be installed for the Toronto General Hospital, Toronto, Ont.; Howard C. Curtis, Southport, N. C., 1 6-ton compression side, and 3-ton raw water ice plant; Mountain Ice & Coal Company, Pueblo, Colo., 1 100-ton refrigerating machine, and miscellaneous material for repairs to plant; New York Agricultural Experimental Station, Pre-emption Switch, N. Y., 1 8-ton refrigerating plant; Emil Sieloff, St. Louis, Mo., 2 motor-driven 11-ton refrigerating plants; Dublin Brothers, Jacksonville, Fla., 1 6-ton refrigerating plant; Maryland Ice Cream & Fruit Products Company, Baltimore, Md., 2 45-ton horizontal double-acting refrigerating machines, 20-ton freezing system, and ice cream plant; Blue Valley Creamery Co., Hastings, Neb., 1 20-ton absorption refrigerating machine and ice cream plant; M. K. Goetz Brewing Company, St. Joseph, Mo., 1 200-ton horizontal double-acting refrigerating compression side, and 30-ton freezing system; Miles Brothers, Grove City, Pa., 1 2-ton refrigerating plant; John M. Albin, Grove City, Pa., 1 2-ton refrigerating plant; Swift & Company, Salem, Mass., 1 20-ton horizontal double-acting refrigerating plant; Niagara Chocolate Company, Niagara Falls, N. Y., 1 20-ton refrigerating plant; Hufnall Dairy, Virginville, Pa., 1 8-ton refrigerating plant; York Ice & Milk Company, York, Pa., 1 20-ton refrigerating plant, and direct expansion piping for large ice storage house.

Sparks From The Advertising Pages

Perhaps the most convincing, and in the long run, the most effective style of technical advertising is that which is known among advertising men as "reason why" copy. This is copy which not only makes definite claims for a product, but which backs up those claims with good solid proof—reasons which explain why the product will do that which is claimed.

"Reason why" copy is especially well suited to advertising which exploits a technical product, because the class of readers to whom this advertising goes, are, by reason of their calling, men of exceedingly analytical minds—minds which must necessarily be approached by copy which will stand the keen analysis to which it is sure to be subjected.

But in the field of stationary engineering the fact that the readers are already so thoroughly familiar with the fundamental principles of practically all the mechanical appliances intended for use in the power plant, and the fact that they can quickly see the advantage of certain points without explanation, enables the advertiser to often attract, hold and convince the reader by merely using a good illustration which shows in itself why the claims made for it are so.

This point is well illustrated by Thos. C. Robinson, who selects the advertisement of W. H. Nicholson & Co., as the most convincing in the May numbers of Practical Engineer, because "the view shown is such as to render possible a study of the automatic eliminator's construction relative to that which is claimed for it in the advertisement." Mr. Robinson says:

Fort Madison, Iowa, May 13th, 1912.

Advertising Editor, Technical Publishing Co.
537 So. Dearborn St., Chicago, Ill.

Gentlemen:—

Replying to Practical Engineer relative to the questions asked about the advertisements, my judgment is: Advertisement of the Ashton Valve Company, May 15th issue, has the strongest attention value, because the general nature or appearance of it imparts to one strong assurance of its importance, and because of its appealing, open countenance of expression gets a reader's credence.

No. 2. Advertisement of The American Well Works, page 105, May 1st issue, is the most interesting because it is a dignified, complete, confidential arrangement of representation, and these attributes, too, are seemingly nourished, substantiated and reinforced by the many hints contained relative to the paramount features and conditions which govern the efficiency of the centrifugal pump.

No. 3. Advertisement of the W. H. Nicholson & Co., page 10, May 15th issue, is the most convincing, because the view shown is such as to render possible a study of the automatic eliminator's construction, relative to that which is claimed for it in the advertisement. The intent is plain and sure, and a few moments' study of it is sure to convince one of the merits claimed for it. The view itself is elaborate, yet simple and conclusive.

No. 4. I have not answered either of the advertisements in the last two issues of Practical Engineer because I have had no reason to, but in the issues previous to these, The Bird Archer Co., Joseph Dixon Crucible Co., A. S. Cameron Co., Magnolia Metal Co. and several others.

Trusting that these attributes we have mentioned cover the paramount characteristics of the best advertisements in the paper from the 3 points of view, I am,

Very truly,
Thos. C. Robinson,
c/o J. C. Sanders,
Fort Madison, Iowa.

Mr. D. L. Shearer, of Knoxville, Tenn., has emphasized the carrying power of "reason why" copy in his criticism of the Schaeffer & Budenberg Mfg. Company's advertisement. He was impressed by this advertisement because it not only talked about securing the greatest operating economy, but it backed that talk up by outlining "a method for testing the plant and securing all the saving possible." Mr. Shearer says:

Knoxville, Tenn, May 14, 1912.

Advertising Editor, Practical Engineer,
Chicago, Ill.

Gentlemen:—

I consider the advertisement of the "International Acheson Graphite Co." to be the most striking, because the entire story of a hot bearing from improper lubrication is told in a graphic way and can be read at a glance.

The advertisement of the "H. W. Johns-Manville Co." is the most interesting, for it deals with a subject that vitally concerns every engineer and many points are brought out in the text which merit the closest consideration.

If we are looking for a convincing advertisement, let us consider that of the "Schaeffer and Budenberg Mfg. Co." Here the point is made, that every engineer should be interested in securing the greatest operating economy, and the method for testing the plant and securing all the saving possible, is plainly outlined.

I answered the following advertisements:
"The Schaeffer and Budenberg Mfg. Co."
"Harbison-Walker Refractories Co."
"Jenkins Bros."

Very truly yours,
David R. Shearer,
Box 22, Knoxville, Tenn.

Both Mr. Robinson and Mr. Shearer have cast their votes for advertisements which are more than mere statements of claimed facts—advertisements which assume that the reader takes nothing for granted, and that whatever statements are made must be proven by figures and facts. This is the style of copy that an engineer likes to read—the style that invariably wins out in the end.

PRACTICAL ENGINEER CLASSIFIED ADVERTISEMENTS

Advertisements in this section are inserted under regular headings at the rates of 30 cents per line. About nine words make a line. No display type allowed, but the first three words may be set in capital letters. Minimum space sold, two lines.

Under classification, "Positions Wanted," advertisements not exceeding four lines will be inserted for subscribers once free of charge.

To insure proper classification, copy must reach this office 10 days preceding publication.

Positions Wanted

POSITION WANTED—By a stationary engineer who had experience with high speed and Corliss engines, condensers, a.c. and d.c. dynamos, and motors; has own steam indicator, and holds chief engineer's license for Minnesota. Can give A1 references. Address Box 231, care Practical Engineer, Chicago, Ill. 7-15-1

POSITION WANTED—Young man desires position in large plant where there is a chance for promotion. Two years' experience. Address W. K. Mann, Box 21, Milan, Mo. 7-15-1

POSITION WANTED—As chief or operating engineer, 10 years' experience on all kinds of steam and electrical power plant machinery. Age, 38; temperate, steady and reliable. Chicago City and State of Minn. chief engineer's license. Address Box 228, Practical Engineer, Chicago, Ill. 7-15-1

POSITION WANTED—By a college engineer, 31 years, single, with over 6 years' outside experience in the running and setting up of steam, gas and gasoline engines of all kinds. Address Box 226, Practical Engineer, Chicago, Ill. 7-15-1

Help Wanted

AGENTS—AT ONCE. Something new. Model Spring Winder. Guaranteed for life. Makes springs any size from any kind of spring wire. Wonderfully rapid. Efficient and powerful machine. Sells quickly to factories, shops, mills, garages, printing houses, newspaper publishers, etc. Indispensable wherever there's a machine with springs on it. Saves time, worry and money. Attaches in a minute to any workbench or table. Sell one, make $2.50 profit. You can sell 10 a day. Big folder tells all. Write National Mfg. & Sales Co., 322 Huron St., Toledo, O. 7-1-3

WOULD ONE HUNDRED DOLLARS per week interest you ? Would you like to be outside in the fresh invigorating air during the coming months? Free to do you own bidding and earning $100.00 or more per week, as you choose? Your own boss. We want one first-class salesman to represent us, in every city in the United States, to sell our high-grade specialties to Engineers. Exclusive territory given. Strong Machinery & Supply Co., 48 Franklin St., N. Y. C. tf

AGENTS WANTED—WE WANT a live-wire agent, either engineer or specialty salesman in every town to furnish lists of names and take orders for Akron Metal Gaskets, the most complete line of metal gaskets made. Write for our proposition. Akron Metallic Gasket Company, Dept. PE., Akron, Ohio. tf

HELP WANTED—ENGINEER WANTED in every city and town to instruct our customers in indicator practice. If you have a fair working knowledge, we will "do the rest." Good pay to reliable, intelligent men. Write for particulars. Lippincott Co., Newark, N. J. tf

WANTED—SALES AGENTS to sell Goetze Metallic Packings of good reputation. Write us. Goetze Gasket & Packing Co., New Brunswick, N. J. 6-15-12

Wanted

WANTED—EVERY ENGINEER to have our pamphlet for setting valves on Corliss Engines, simple and compound, with one or two eccentrics. Sent free. Lindstrom's Machine Works, 200 South Third St., Allentown, Pa. tf

WANTED—WE WANT TO BUY a good patented Steam Specialty. Address Box 233, Practical Engineer, Chicago, Ill. 7-1-2

WANTED—ALL STEAM USERS to have clean boilers without using compounds or chemicals in any form. Write "Otis," No. 317 Norfolk Ave., Buffalo, N. Y. tf

IF YOU ARE a night engineer, spend a few hours each day taking subscriptions for Practical Engineer. You will be paid well. Write the Subscription Dept. They will start you in at once. tf

For Sale

FOR SALE—HIGH PRESSURE BOILERS 54x16, 60x16, 66x16, 72x18. Corliss Engines 10x30, 12x36, 14x36, 16x42, 18x36, 18x42. Generators, Motors, Miscellaneous Machinery. The Randle Machinery Co., 1767 Powers St., Cincinnati, Ohio. 7-15-tf

FOR SALE—100 H. P. SCOTCH MARINE boiler, Hartford insurance 125 lb., 18 months old. Triple riveted, butt-seam, $500 f. o. b. Sunbury, Ohio, also 12x36 Harris Corliss engine, $400, Duzets & Son, 44 Church St., New York. 7-15-2

FOR SALE—INDICATOR, REDUCING WHEEL, planimeter, best make, in fine order. Examination allowed before payment, Price low—in fact, a sacrifice. Address Mrs. N. L. Browning, East Orange, N. J. tf

FOR SALE—500 HORSEPOWER right-hand engine; simple Corliss heavy duty frame, size 24x48, complete, including flywheel, 18 ft. diameter, grooved for 14 turns 1⅜-in. rope, American drive-steam receiver separator, 7-in. steam pipe including one long radius bend and flanges; can be seen in operation at our mill in Mt. Carmel, Ill. Address Bernet Craft & Kauffman Mlg. Co. Office 1036 Pierce Building, St. Louis, Mo. 7-1-4

FOR SALE—WAINWRIGHT HEATER, 400 H. P. copper corrugated tubes, excellent condition, low price, Harris Machinery Co., Minneapolis, Minn. 7-1-6

Patents and Patent Attorneys

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Building, Washington, D. C. tf

PATENTS OF VALUE—Prompt and efficient service. No misleading inducements. Expert in Mechanics, Book of Advice and Patent Office Rules free. Clements & Clements, Patent Attorneys, 727 Colorado Bldg., Washington, D. C. 5-15-6

PATENTABLE IDEAS WANTED—Send for 3 free books. A. B. Owen, 28 Owen Bldg., Washington, D. C. tf

Educational and Instruction

FREE TUITION BY MAIL—Civil service, drawing, engineering, electric wiring, agricultural, poultry, real estate, automobile, law, normal, academic, bookkeeping, shorthand courses. Matriculation, $5. Write for our free plan. Apply to CARNEGIE COLLEGE, Rogers, Ohio. 5-15-6

Miscellaneous

IRON, BRASS and Aluminum Castings, Metal Specialties, Patterns, Models, Polishing, Plating and Japanning, North Chicago Tool Works, 65 Grove Ave., North Chicago, Ill. 6-1-12

EVERY ENGINEER should be posted regarding the new system of vacuum heating installed without payment of royalty; I have valuable information; write today. M. Y. C., 1413 W. Jackson Blvd., Chicago, Ill. tf

MAKE MONEY on the side. Here's your chance to pick out some money for yourself. Get subscriptions for Practical Engineer. It pays well. Just drop a line to the Subscription Dept. They will tell you how. tf